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(54) Title: HERBICIDAL PYRIMIDINES AND TRIAZINES

(57) Abstract

This invention relates to certain herbicidal sulfonylure pyrimidines and triazines useful for complete control and/or selective control of vegetation with the selectivity being important to agronomic crops.

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TITLE

HERBICIDAL PYRIMIDINES AND TRIAZINES

Related Applications

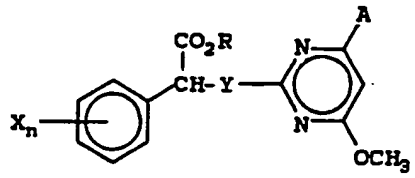
This is a continuation-in-part of U.S. Serial No. 07/542390 filed June 22, 1990 which is a continuation-in-part of U.S. Serial No. 07/463,356 filed January 11, 1990.

Background of the Invention

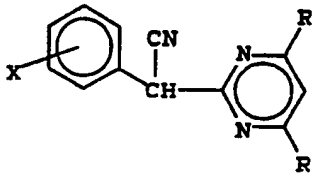
This invention relates to certain herbicidal pyrimidines and triazines, agriculturally suitable compositions thereof and a method for their use as general or selective preemergent or postemergent herbicides or as plant growth regulants.

New compounds effective for controlling the growth of undesired vegetation are in constant demand. In the most common situation, such compounds are sought to selectively control the growth of weeds in useful crops such as cotton, rice, corn, wheat and soybeans, to name a few. Unchecked weed growth in such crops can cause significant losses, reducing profit to the farmer and increasing costs to the consumer. In other situations, herbicides are desired which will control all plant growth. Examples of areas in which complete control of all vegetation is desired are areas around railroad tracks, storage tanks and industrial storage areas. There are many products commercially available for these purposes, but the search continues for products which are more effective, less costly and environmentally safe.

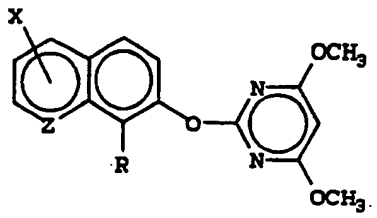
JP Kokai Hei 1[1989]-301668 discloses mandelic acid derivatives as herbicides:



J. Chem. Res.(S) 1977, 186 discloses benzyl pyrimidines as intermediates to herbicides but includes no herbicidal test data for these intermediates.



JP KOKAI HEI 2[1990]-56469 (unofficial English translation) discloses as herbicides the following structures:



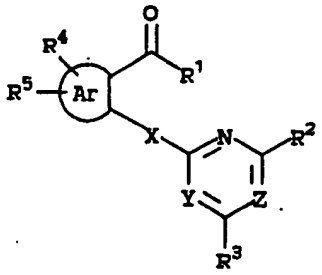
wherein, inter alia

Z is CH or N;

R is a formyl group or CO_2R^1; and

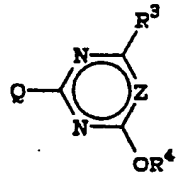
R^1 is H, lower alkyl, lower alkoxyalkyl or lower alkylthioalkyl.

EP-A-360,163 discloses herbicidal compounds of the formula:



SUMMARY OF THE INVENTION

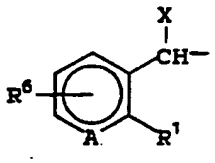
This invention pertains to compounds of Formula I including all geometric and stereoisomers, agriculturally suitable salts, agricultural compositions containing them and their method-of-use for the control of unwanted weeds both preemergence and postemergence.



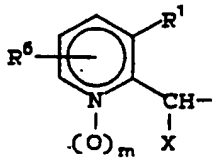
I

wherein

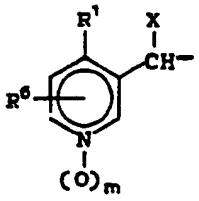
Q is



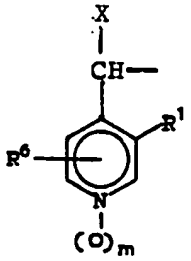
Q-1



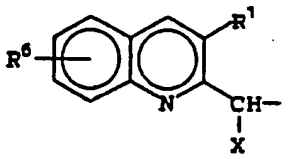
Q-2



Q-3

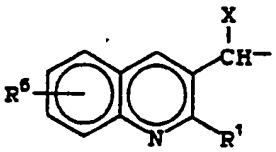


Q-4

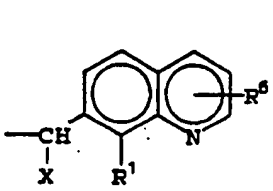


Q-5

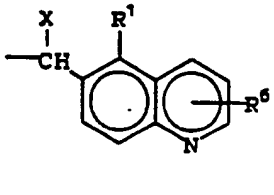
or



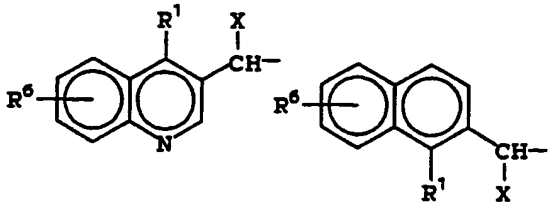
Q-6



Q-7



Q-8



Q-9 Q-10

A is CR^2, N or N-O;

X is H, F, Cl, CH_3, OH, $C(O)NR^{12}R^{13}$, CO_2R^{14} or CN;

R^1 is H, CHO, $C(OCH_3)_2H$, CO_2R^5 or $C(O)SR^{11}$;

R^2 is H, F, Cl, C_1-C_2 alkyl, C_1-C_2-alkoxy, C_2-C_3 alkynyl, C_2-C_3 alkenyl, $S(O)_nC_1$-C_2 alkyl, NO_2, phenoxy, C_2-C_4 alkylcarbonyl, $C(OCH_3)_2CH_3$, or $C(SCH_3)_2CH_3$;

R^3 is C_1-C_2 alkyl, C_1-C_2 alkoxy, OCF_2H or Cl;

R^4 is C_1-C_2 alkyl;

R^5 is H; M; C_1-C_3 alkyl; C_2-C_3 haloalkyl; allyl; propargyl; benzyl optionally substituted with halogen, C_1-C_2 alkyl, C_1-C_2 alkoxy, CF_3, NO_2, SCH_3, $S(O)CH_3$, or $S(O)_2CH_3$; C_2-C_4 alkoxyalkyl; $N{=}CR^7R^8$; or $CHR^9S(O)_nR^{10}$;

R^6 is H, F, Cl, CH_3, OCH_3 or $S(O)_nCH_3$;

R^7 is Cl, C_1-C_2 alkyl or SCH_3;
R^8 is C_1-C_2 alkyl, CO_2(C_1-C_2 alkyl) or $C(O)N(CH_3)_2$;
R^9 is H or CH_3;
R^{10} is C_1-C_3 alkyl or phenyl optionally substituted with halogen, CH_3, OCH_3 or NO_2;
R^{11} is C_1-C_2 alkyl or benzyl;
R^{12} is H or CH_3;
R^{13} is H or CH_3;
R^{14} is H, C_1-C_3 alkyl, C_2-C_5 haloalkyl, C_3-C_5 alkenyl, C_3-C_5 alkynyl, C_2-C_5 alkoxyalkyl or benzyl optionally substituted with CH_3, OCH_3, SCH_3, halogen, NO_2 or CF_3;
m is 0 or 1;
n is 0, 1 or 2;
M is a alkali metal atom or an alkaline earth metal atom, an ammonium group or an alkylammonium group; and
Z is CH or N.

and their agriculturally suitable salts;

provided that:

(a) when R^1 is H, then X is CO_2R^{14};
(b) when X is CO_2R^{14}, then R^1 is H; and
(c) when Z is N, then R^3 is C_1-C_2 alkyl or C_1-C_2 alkoxy.

In the above definitions, the term "alkyl", used either alone or in compound words such as "haloalkyl" includes straight chain or branched alkyl, e.g., methyl, ethyl, n-propyl, isopropyl or the different butyl isomers.

"Alkoxy", "alkenyl" and "alkynyl" analogously also includes straight chain or branched isomers.

"Halogen", either alone or in compound words such as "haloalkyl", means fluorine, chlorine, bromine or iodine. Further, when used in compound words such as "haloalkyl" said alkyl may be partially or fully substituted with halogen atoms, which may be the same or different. Examples include CF_3, CH_2CF_3, CH_2CH_2F, CF_2CF_3 and CH_2CHFCl.

The preferred compounds of the invention for reasons including ease of synthesis and/or greater herbicidal efficacy are:

1. Compounds of Formula I wherein
   Q is Q-1 or Q-2;

2. Compounds of Preferred 1 wherein
   R^2 is H, F, Cl, CH_3, SCH_3, OCH_3 or OCH_2CH_3;

3. Compounds of Preferred 2 wherein
   R^6 is H;
   Z is CH;
   R^3 is OCH_3;
   R^4 is CH_3; and
   X is H;

4. Compounds of Preferred 2 wherein
   R^6 is H or 3-F;
   Z is CH;
   R^3 is OCH_3;
   R^4 is CH_3;
   X is CO_2R^{14}; and
   R^{14} is C_1-C_3 alkyl, allyl, propargyl or benzyl;

5. Compounds of Preferred 3 wherein
Q is Q-1;
R^1 is CO_2R^5; and
R^5 is H or M;

6. Compounds of Preferred 3 wherein
Q is Q-2;
R^1 is CO_2R^5; and
R^5 is H or M;

7. The compound of Preferred 5 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid;

8. The compound of Preferred 2 which is 2-[cyano(4,6-dimethoxy-2-pyrimidinyl)methyl]-benzoic acid;

9. The compound of Preferred 5 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl benzoic acid, sodium salt;

10. The compound of Preferred 5 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-3-pyridine carboxylic acid;

11. The compound of Preferred 4 which is ethyl 4,6-dimethoxy-alpha-phenyl-2-pyrimidineacetate.

The compounds of this invention are biologically active as herbicides both post and preemergent with selectivity to crops including barley, wheat, corn and cotton.

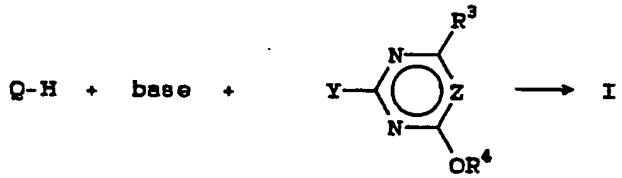
Detailed Description of the Invention

Synthesis

The compounds of Formula I can be prepared by one or more of the following methods described in Equations 1 to 4.

The compounds of Formula I can be prepared by the reaction of an anion, formed from intermediate II and a base, with heterocycle III as shown in Equation 1.

Equation 1



II III

wherein:

Q-1 to Q-6, Z, R^3 and R^4 are as previously defined;

Y is Cl, Br, I, SO_2CH_3 and SO_2benzyl; and within the values of Q, R^1 is $C(OMe)_2H$, CH_2OH, CO_2R^5 or C(O)N(H, alkyl)(alkyl, silylalkyl); and

X is H.

The reaction wherein a benzylic anion is formed, is best carried out in a dry inert solvent

such as hexane, benzene, diethyl ether or tetrahydrofuran (THF). Appropriate bases include hindered amine bases, such as lithium diisopropylamide (LDA) or alkyllithiums, such as methyllithium or magnesium salts, such as ethyl magnesium bromide. When R^1 contains an acidic group, a second equivalent base is required. Formation of benzylic anions is further taught by Y. Thebtaranonth et al in Synthesis, 1986, 785; in Tet. Let., 1989, 30, 3861; J. Staunton et al. in J. Chem. Soc. Perkin Trans. I, 1984, 1043-1051, and F. Hauser et al. Synthesis, 1980, 72. The reaction can be carried out from low temperatures -78°C (dry ice/acetone) up to the reflux point of the solvent. Generally, a lower temperature is preferred for anion formation, while the coupling of the anion II and III proceeds readily at higher temperatures.

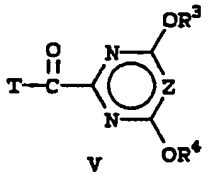
When the reaction is judged complete, it is worked up in one of two manners, depending on the R^1 group. If R^1 contains an acidic group such as CO_2H, then the reaction is extracted into aqueous base, and the water layer acidified. Alternately, the carboxylate can be alkylated in situ to give an alkyl or benzyl ester. The product is either collected by filtration or extracted with an organic solvent and concentrated. The residue is further purified by trituration, crystallization or chromatography in the appropriate solvent. If the R^1 group contains no acidic group, i.e., an isopropylester, then the reaction is quenched with brine, the organic layer separated and concentrated followed by the appropriate purification to give the desired product.

The compounds of Formula I can be prepared by the reaction of a cyanomethyl derivative IV with

heterocycle III as shown in Equation 2a followed by oxidation, then reduction to give the alcohol, which can be converted to the halomethyl derivative (X is F or Cl), or further reduced to the methylene derivative (X is H).

Equation 2

2a) $T\text{-}CH_2CN$ (IV) + III ⟶ I (X=CN)

2b) I (X=CN) + [O] ⟶  (V)

2c) V ⟶ I (X=OH)

2d) I (X=OH) ⟶ I (X=F or Cl)

2e) V ⟶ I (X=H)

2f) I (X=CN) ⟶ I ($X=CO_2H$ or $C(O)NH_2$)

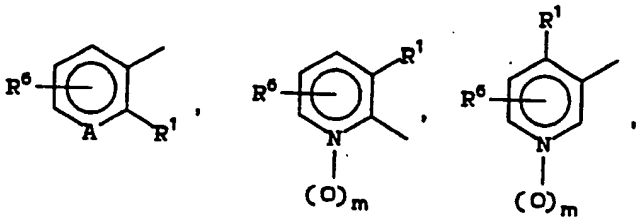
2g) I ⟶ I
X=CO_2H X=CO_2R or $C(O)NR^{12}R^{13}$
R is equivalent to R^5

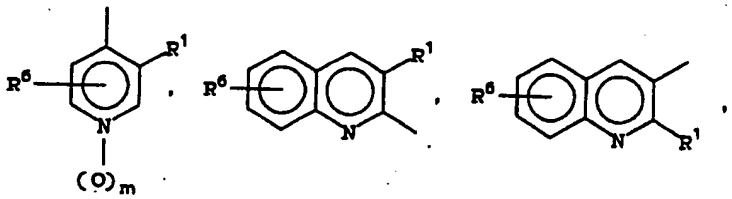
2h) I ⟶ I
X=CO_2H or CO_2R X = H

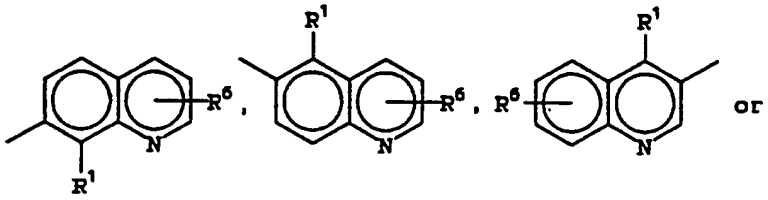
2i) $TCH_2CO_2R^{14}$ + III ⟶ I
X=CO_2R^{14}

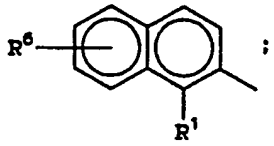
wherein:

T is









R^1 is $C(OMe)_2H$, Br, CN, $CH_2OSiMe_2CMe_3$ or CO_2R^5;
R^5 is H, M, $CHMe_2$ or CMe_3; and
A and R^6 are as previously defined.

The reaction of Equation 2a wherein Y is Cl or Br can be conveniently carried out under $S_{rn}1$ conditions by preparing a mixture of one equivalent or more of potassium metal, a catalytic amount of an iron compound, i.e., ferric nitrate, in liquid

ammonia. The arylacetonitrile IV is added followed by the dropwise addition of the haloheterocycle III, with concomitant irradiation from a photoreactor lamp which emits maximally at 350 nm. The reaction is irradiated from 1 to 24 hours, then the reaction is quenched with solid ammonium chloride, the ammonia is allowed to slowly evaporate. The residual material is rinsed with diethylether and the filtrate is subjected to purification by recrystallization or chromatography to give the desired product. Procedures can be adapted from J. F. Wolfe et al., J. Het. Chem., 1987, 24, 1061.

Alternatively, the reaction of Equation 2a, wherein Y is Cl, Br, I, CH_3SO_2 or $PhCH_2SO_2$, is carried out under basic conditions.

The starting materials can be premixed in an inert solvent such as diethylether, THF or dimethylformamide (DMF) solvent when Y is halogen, followed by addition of a strong base, such as an alkali metal hydride, i.e., NaH, or a hindered metallated base, i.e., LDA or potassium t-butoxide. Another order of addition for any Y value can be the formation of the anion of acetonitrile IV in an inert solvent, followed by its addition to the heterocycle in an inert solvent. Yields are generally increased with the use of dry solvents and dry inert atmospheres, with temperatures that range from -78°C to the solvent reflux point. The reaction is neutralized and the product is isolated by chromatography or crystallization. Analogous reactions are taught by R. Y. Ning et al., J. Med. Chem., 1977, 20, 1312 and F. Sauter et al., J. Chem. Res.(S), 1977, 186.

Reactions 2a and 2b can be carried out concurrently by allowing the reaction to be exposed to oxygen in the atmosphere. The oxidation of I (X is CN) to a diaryl ketone V can be carried out by one of several procedures. S. Murahashi et al., Syn. Lett., 1989, 62, teach the oxidation of alkanenitriles with ruthenium catalyzed t-butyl hydroperoxide to give intermediate 2-(t-butyldioxy)-alkanenitriles, which are further oxidized by titanium tetrachloride.

Diarylketones V can be reduced directly to the diarylmethanes via Equation 2e by Wolff-Kishner conditions as taught by Cram et al., J. Am. Chem. Soc., 1962, 84, 1734; Clemmensen conditions as taught by Yamamura and Hirata, J. Chem. Soc. C, 1968, 2887; or hydrogenation with a catalyst such as $CuCr_2O_4$.

The diarylketones V can also be reduced stepwise to the alcohol, I (X=OH), with lithium aluminum hydride or sodium borohydride. The alcohol can be converted to the chloride with thionyl chloride or methanesulfonyl chloride and triethylamine and to the fluoride with "DAST" (diethylaminosulfur trifluoride), see Synthesis, 1973, 787 and J. Org. Chem., 1975, 40, 574, as shown in Equations 2c and 2d.

Cyanomethanes of Formula I (X=CN) can be converted to carboxylic acids and amides by hydrolysis with either base or acid, as shown in Equation 2f.

Carboxylic acids I ($X=CO_2H$) can be esterified or converted to amides by methods well known to a chemist skilled in the art.

Equation 2h shows that compounds of Formula I ($X=CO_2R$) can be decarboxylated to the methylene

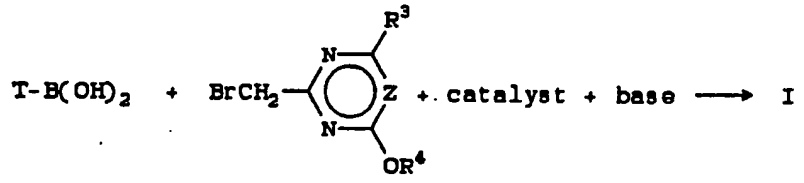
bridged compounds. Such decarboxylations are well known in the art and generally are accomplished by heating the compound with or without solvent and with or without a catalyst.

Equation 2i is carried out in a similar fashion to 2a wherein an appropriate base is reacted with the aryl acetate followed by addition of heterocycle III.

The cyanomethanes and arylacetates of Formula IV are either known in the art or prepared by simple modifications thereof. Cyanomethanes are most conveniently prepared by nucleophilic reaction of a metal cyanide, i.e., NaCN, with a benzyl halide in a suitable solvent, such as dimethylformamide, dimethylsulfoxide or THF. The benzyl halides are also well known, and easily prepared from II by methods adapted from T. Eicher, Synthesis, 1988, 1, 525 and Clarke et al., J. Chem. Perkin Trans. I, 1984, 1501.

The compounds of Formula I can be prepared by a cross-coupling reaction between an aryl boronic acid and a bromomethyl heterocycle with a catalyst as shown in Equation 3.

Equation 3



VI VII

wherein:

T, Z, R^3 and R^4 are as previously defined;

R^1 is $C(OMe_2)H$, CH_2OH, CO_2R^5 or $CON(H,CH_3)$-(alkyl, alkylsilyl); and

R^5 is H, M, isopropyl or t-butyl.

The reaction is carried out by mixing the bromide (VII) with a transition metal catalyst, such as Ni(O) or Pd(O), preferably $Pd(PPh_3)_4$ in a suitable solvent, such as toluene or glyme, followed by the addition of boronic acid VI and the base, such as an alkoxide, hydroxide or carbonate, for example NaOEt, NaOH or Na_2CO_3 in a suitable solvent such as water or ethanol. The reaction mixture is stirred from 1 to 24 hours at room temperature to reflux. At completion, the reaction is filtered, and the filtrate is concentrated. The residue is partitioned between brine and an organic solvent (EtOAc, CH_2Cl_2), separated, dried (Na_2SO_4, $MgSO_4$), and concentrated, whereupon the product is isolated and purified, if necessary, by flash chromatography, recrystallization or distillation. Similar procedures and modifications can be found in Snieckus et al., Tet. Let., 1987, 28, 5093; ibid., 1985, 26, 5997; Yamamoto et al., Synthesis, 1986, 564; Suzuki et al. Synth. Comm., 1981, 11, 513 and references incorporated therein.

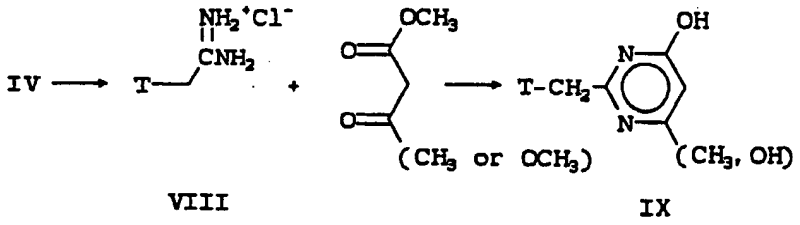
Formation of aryl boronic acids, VI , is well known in the art. They can be prepared by contacting an aryl organo metallic compound with $B(OMe)_3$ followed by acidic workup, as in J. Org. Chem., 1984, 49, 5237 and Tetrahedron, 1983, 39, 1955; or by reaction of an arylsilane with BBr_3, followed by

addition of methanol, then dilute acid, as described in Tet. Let., 1987, 28, 5093.

Bromomethanes VII can be prepared by well known methods for conversion from alcohols and from methyl groups. A representative example is described in J. Het. Chem., 1989, 26, 913.

Compounds of Formula I, wherein Z is CH, can be prepared by the route shown in Equation 4.

Equation 4



VIII IX

IX → I

(Z is CH)

The reaction is carried out by reacting IV with hydrogen chloride in an alcohol to form an imidate which is converted to the amidine salt, VIII, with ammonia. The pyrimidinol IX is formed by condensation with a diketone/ester. This sequence of reactions and similar modifications can be found in H. C. van der Plas et al., Tetrahedron, 1989, 45, 6511-6518. Compounds of Formula IX can be converted

to instant compounds I by preparation of the chloropyrimidine with phosphorus oxychloride and a catalytic amount of DMF and subsequent displacement with sodium methoxide or ethoxide.

Heterocycles of Formula III are generally known in the art or can be prepared by simple modifications thereof. For example, preparation of chlorotriazines is described in J. Am. Chem. Soc., 1951, 73, 2989, while chloropyrimidines are described in J. Chem. Soc. (C), 1966, 2031. General references, particularly to aminoheterocycles, can be found in "The Chemistry of Heterocyclic Compounds", a series published by Interscience Publishers, Inc., New York and London. The alkylsulfonyl and benzylsulfonyl heterocycles can also be prepared by the general reference above and more specifically by alkylation of thiols, as described in J. Med. Chem., 1984, 27, 1621-1629, followed by oxidation, most commonly by m-chloroperoxybenzoic acid.

The arylmethanes of Formula II are known in the art or easily prepared by methods therein.

The R^1 groups of Equations 1 to 4 can be converted into the claimed R^1 groups by techniques well known to one skilled in the art. For example, benzyl alcohols can be oxidized to aldehydes with many reagents, including pyridinium chlorochromate (PCC) and/or further oxidized to the carboxylate with potassium permanganate ($KMnO_4$). A sample procedure involving a phase transfer reagent is found in Can. J. Chem., 1989, 67, 1381.

Additionally, conversion to and from various preferred R^1 groups are well known to one skilled in the art. Many are described in T. Greene, Protective

Groups in Organic Synthesis, 1981, John Wiley and Sons, New York.

Carboxylic acid salts of Formula I (R^1 is CO_2M) can be prepared by reacting the carboxylic acid of Formula I (R^1 is CO_2H) with a base in the presence or absence of a solvent within a temperature range from room temperature to the boiling point of the solvent from 5 minutes to 24 hours. The solvent may be a hydrocarbon such as benzene or toluene, a halogenated hydrocarbon such as methylene chloride or chloroform, an alcohol such as methanol, ethanol or isopropanol, and other solvents, such as ethyl ether, THF, acetone, methyl ethyl ketone, ethyl acetate or acetonitrile. The base may be an alkali metal such as sodium metal or potassium metal, an alkali metal or alkaline earth metal hydride such as sodium hydride, potassium hydride or calcium hydride, a carbonate such as sodium carbonate, potassium carbonate or calcium carbonate, or a metal hydroxide such as sodium hydroxide or potassium hydroxide. The organic base may be ammonia, an alkylamine (primary amine), a dialkylamine (secondary amine) or a trialkylamine (tertiary amine).

Example 1

2-[(4,6-Dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid

To a cooled (15°C) suspension of sodium hydride (8.79 g, 0.183 mol), prewashed with dry hexanes, in 300 mL anhydrous THF under an N_2 atmosphere was added 2,6-dimethylbenzoic acid (24.5 g, 0.166 mol), portionwise. Additional THF (300 mL) was added to facilitate stirring in the resultant slurry. Then 142 mL of 1.4 M methyllithium (0.199 mol) was added

dropwise at room temperature. One-twelfth of the resultant red solution (50 mL, 0.0138 mol), was added to 1.50 g of 4,6-dimethoxy-2-(methylsulfonyl)-pyrimidine (0.068 mol) under N_2 at room temperature. After 4 hours, the reaction was diluted with 100 mL 1N HCl and 100 mL brine. The layers were separated; the aqueous layer was extracted with 100 mL ethyl acetate. The combined organic layers were dried ($MgSO_4$), filtered and concentrated to give 2.5 g of a yellow oil. Addition of Et_2O gave a small amount of white precipitate, which was removed by filtration. The filtrate was subjected to flash column chromatography (40 mm x 6" of SiO_2), eluted with 25% ethyl acetate/hexanes (v/v), initially, then 50:49:1 ethyl acetate in hexane/methanol. The fractions containing product were collected and concentrated under reduced pressure. The resultant oil crystalized on standing to give 0.41 g solid, m.p. 122-124°C.

IR (nujol) = 1710 cm^{-1}.

Mass Spec. m/e = 289 (100, M+1).

PMR (200 MHz, $CDCl_3$) δ 2.49 (s, CH_3, 3H), 3.5-3.9 (bs, OH, 1H), 3.93 (s, OCH_3, 6H), 4.15 (s, CH_2, 2H), 5.91 (s, pyrm-H, 1H), 7.0-7.3 (m, ArH, 3H).

Example 2

2-[Cyano(4,6-dimethoxy-2-pyrimidinyl)methyl]-benzoic acid

a) To a suspension of 60% NaH (0.38 g, prewashed with hexanes) in 50 mL dry THF was simultaneously added methyl 2-cyanomethylbenzoate (1.6 g) and 4,6-dimethoxy-2-methylsulfonylpyrimidine (1.99 g) in dry THF. After addition, the reaction was refluxed

for 2 days, then 1.0 g of potassium t-butoxide was added. After 1 day, the reaction was quenched with 25 mL of brine and neutralized with 1 N HCl. The organic layer was concentrated under reduced pressure to give 2.87 g of an oil. The oil was subjected to flash column chromatography (SiO_2), eluted with EtoAc/hexane (1:9) to give 0.75 g of solid, m.p. 79-81°C.

PMR (200 MHz, $CDCl_3$) δ 3.86 (s, OCH_3, 6H), 3.90 (s, OCH_3, 3H), 5.89 (s, pyrm-H, 1H), 6.74 (s, CHCN, 1H), 7.35-8.05 (m, ArH, 4H).

b) The product of 2a (0.43 g) was dissolved in a solution of 1.6 mL of 12% aqueous NaOH and 12 mL of ethanol. After 12 hours, the reaction mixture was diluted with 15 mL of .4 M NaOH and washed with Et_2O. The aqueous layer was acidified, then extracted with EtOAc. The organic layer was concentrated under reduced pressure and the residue was triturated with butyl chloride to give 0.15 g solid, m.p. 214-216°C.

NMR (90 MHz, $CDCl_3$) δ 3.9 (s, OCH_3), 6.0 (s, pyrm-H, 1H), 6.9 (s, CHCN, 1H), 7.4-8.3 (m, ArH, 4H), 11.0 (bs, CO_2H, 1H).

Example 3

2-[(4,6-Dimethoxy-2-pyrimidinyl)methyl]-3-pyridinecarboxylic acid

To a cooled (-78°C) suspension of 2-methylnicotinic acid (1.4 g, 10.2 mmol) in 100 mL dry THF was added 11.25 mL 1.95 M LDA dropwise. The reaction turned purple and warmed to -65°C. Allowed to recool to -78°C, then added 2-chloro-4,6-dimethoxy-pyrimidine (1.75 g, 10 mmol). The reaction was

allowed to warm to room temperature over 2 days. The solvent was removed under reduced pressure. The residue was partitioned between Et_2O and water, which was basified to pH 8-9. The aqueous layer was acidified, then extracted with EtOAc, dried ($MgSO_4$), and concentrated under reduced pressure to give 1.33 g of a brown oil. This oil was subjected to flash column chromatography on SiO_2, eluted with 97:2:1 (EtOAc:MeOH:HOAc), to give after trituration with BuCl/hexanes a solid, 0.29 g, m.p. 182-186°C.
Mass Spec.: m/e 276 (100, MH^+).
PMR (acetone-d_6, 200 MHz) δ 3.8 (s, OMe, 6H), 4.8 (s, CH_2, 2H), 5.9 (s, pyrm-H, 1H), 7.4 (m) + 8.3 (m) + 8.7 (m)[pyrH, 3x 1H].

Example 4

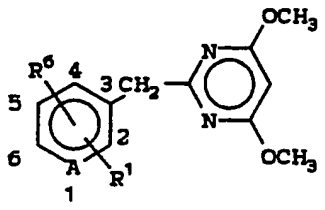
4,6-Dimethoxy-α-phenyl-2-pyrimidineacetic acid, ethyl ester.

To a cooled (-78°C) solution of ethyl phenylacetate (0.79 ml, 5mmol) in 30 mL anhydrous THF under an N_2 atmosphere was added 2.86 mL of 1.9M LDA dropwise, followed by 1.0 g of 4,6-dimethoxy-2-methylsulfonylpyrimidine. The reaction mixture was allowed to warm to room temperature over 6 h then quenched with 20 mL brine and 5 mL of 1 NHCl. The layers were separated and the aqueous layer was extracted with ethyl acetate. The combined organic layers were washed once with brine, dried ($MgSO_4$), filtered and concentrated under reduced pressure to give 1.6 g of a brown oil. The oil was subjected to flash column chromatography (SiO_2), eluted with Et_2O/hexanes (1:9) to give 0.63g of the product as an oil. PMR (200 MH_z, $CDCl_3$) δ 1.24 (t, CH_3, 3H), 3.89

(S, OCH_3, 6H), 5.08 (S, CH, 1H), 5.89 (s, pyrmH, 1H), 7.2-7.6 (m, ArH, 5H).

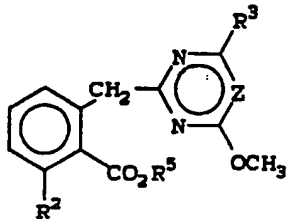
Using the procedures of Equations 1 to 4 and Examples 1 to 4, the compounds of Tables 1 to 7 can be prepared by one skilled in the art.

TABLE 1



A	R^1	R^6	A	R^1	R^6
N	2-CHO	H	CH	2-CHO	H
N	2-CHO	4-Cl	CCH_3	2-CHO	H
N	$2-CO_2H$	H	CCl	2-CHO	H
N	$2-CO_2H$	4-F	$COCH_3$	2-CHO	H
N	$2-CO_2H$	$5-OCH_3$	CH	2-CHO	4-F
N	$2-CO_2H$	$6-SCH_3$	CH	$2-CO_2H$	4-F
N	$2-CO_2CH_3$	H	CH	$2-CO_2H$	$4-OCH_3$
N	$2-CO_2CH_2CH=CH_2$	H	CH	$2-CO_2H$	$4-OCH_2CH_3$
N	$2-CO_2CH_2C\equiv CH$	H	$CC(OMe)_2CH_3$	$2-CO_2H$	H
N	$2-CO_2CH_2C_6H_5$	H	COC_6H_5	$2-CO_2H$	H
N	$2-CO_2CH_2-3-Cl-C_6H_4$	H	CH	$2-CO_2CH_3$	4-Cl
N	$2-CO_2Na$	H	CH	$2-CO_2CH_3$	$4-SCH_3$
N	$2-CO_2H \cdot NH_2CHMe_2$	H	CH	$2-CO_2CH_3$	$6-SO_2CH_3$
N-O	$2-CO_2H$	H	CH	$2-CO_2CH_3$	5-Cl
N	4-CHO	H			
N	$4-CO_2H$	H			
N	$4-CO_2Na$	H			
N	$4-CO_2H$	5-Cl			

TABLE 2



R^5	R^2	R^3	Z	R^5	R^2	R^3	Z
H	H	CH_3	CH	H	OCH_2CH_3	OCH_3	CH
H	H	Cl	CH	H	C≡CH	CH_3	CH
H	H	OCH_3	CH	H	C≡CH	Cl	CH
H	F	CH_3	CH	H	C≡CH	OCH_3	CH
H	F	Cl	CH	H	SCH_3	CH_3	CH
H	F	OCH_3	CH	H	SCH_3	Cl	CH
H	Cl	CH_3	CH	H	SCH_3	OCH_3	CH
H	Cl	Cl	CH	H	H	CH_3	N
H	Cl	OCH_3	CH	H	H	CH_2CH_3	N
H	CH_3	CH_3	CH	H	H	OCH_3	N
H	CH_3	Cl	CH	H	F	CH_3	N
H	CH_3	OCH_3	CH	H	F	CH_2CH_3	N
H	CH_2CH_3	CH_3	CH	H	F	OCH_3	N
H	CH_2CH_3	Cl	CH	H	Cl	CH_3	N
H	CH_2CH_3	OCH_3	CH	H	Cl	CH_2CH_3	N
H	OCH_3	CH_3	CH	H	Cl	OCH_3	N
H	OCH_3	Cl	CH	H	CH_3	CH_3	N
H	OCH_3	OCH_3	CH	H	CH_3	CH_2CH_3	N
H	OCH_2CH_3	CH_3	CH	H	CH_3	OCH_3	N
H	OCH_2CH_3	Cl	CH	H	CH_2CH_3	CH_3	N

R^5	R^2	R^3	Z
H	CH_2CH_3	CH_2CH_3	N
H	CH_2CH_3	OCH_3	N
H	OCH_3	CH_3	N
H	OCH_3	CH_2CH_3	N
H	OCH_3	OCH_3	N
H	OCH_2CH_3	CH_3	N
H	OCH_2CH_3	CH_2CH_3	N
H	OCH_2CH_3	OCH_3	N
H	$C\equiv CH$	CH_3	N
H	$C\equiv CH$	CH_2CH_3	N
H	$C\equiv CH$	OCH_3	N
H	SCH_3	CH_3	N
H	SCH_3	CH_2CH_3	N
H	SCH_3	OCH_3	N
H	SCH_2CH_3	CH_3	CH
H	SCH_2CH_3	Cl	CH
H	SCH_2CH_3	OCH_3	CH
H	$SOCH_3$	CH_3	CH
H	$SOCH_3$	Cl	CH
H	$SOCH_3$	OCH_3	CH
H	SO_2CH_3	CH_3	CH
H	SO_2CH_3	Cl	CH
H	SO_2CH_3	OCH_3	CH
H	$SO_2CH_2CH_3$	CH_3	CH
H	$SO_2CH_2CH_3$	Cl	CH
H	$SO_2CH_2CH_3$	OCH_3	CH
H	OC_6H_5	CH_3	CH
H	OC_6H_5	Cl	CH
H	OC_6H_5	OCH_3	CH
H	SCH_2CH_3	CH_3	N
H	SCH_2CH_3	CH_2CH_3	N
H	SCH_2CH_3	OCH_3	N
H	$SOCH_3$	CH_3	N
H	$SOCH_3$	CH_2CH_3	N
H	$SOCH_3$	OCH_3	N
H	SO_2CH_3	CH_3	N
H	SO_2CH_3	CH_2CH_3	N
H	SO_2CH_3	OCH_3	N
H	$SO_2CH_2CH_3$	CH_3	N
H	$SO_2CH_2CH_3$	CH_2CH_3	N
H	$SO_2CH_2CH_3$	OCH_3	N
H	OC_6H_5	CH_3	N
H	OC_6H_5	CH_2CH_3	N
H	OC_6H_5	OCH_3	N
CH_3	H	CH_3	CH
CH_3	H	Cl	CH
CH_3	H	OCH_3	CH
CH_3	F	CH_3	CH
CH_3	F	Cl	CH
CH_3	F	OCH_3	CH
CH_3	Cl	CH_3	CH
CH_3	Cl	Cl	CH
CH_3	Cl	OCH_3	CH
CH_3	CH_3	CH_3	CH
CH_3	CH_3	Cl	CH
CH_3	CH_3	OCH_3	CH
CH_3	CH_2CH_3	CH_3	CH
CH_3	CH_2CH_3	Cl	CH
CH_3	CH_2CH_3	OCH_3	CH
CH_3	OCH_3	CH_3	CH
CH_3	OCH_3	Cl	CH
CH_3	OCH_3	OCH_3	CH
CH_3	OCH_2CH_3	CH_3	CH
CH_3	OCH_2CH_3	Cl	CH
CH_3	OCH_2CH_3	OCH_3	CH
CH_3	$C\equiv CH$	CH_3	CH

R^5	R^2	R^3	Z
CH_3	$C\equiv CH$	Cl	CH
CH_3	$C\equiv CH$	OCH_3	CH
CH_3	SCH_3	CH_3	CH
CH_3	SCH_3	Cl	CH
CH_3	SCH_3	OCH_3	CH
H	CH_3	CH_3	N
H	CH_3	CH_2CH_3	N
H	CH_3	OCH_3	N
H	F	CH_3	N
H	F	CH_2CH_3	N
H	F	OCH_3	N
H	Cl	CH_3	N
H	Cl	CH_2CH_3	N
H	Cl	OCH_3	N
H	CH_3	CH_3	N
H	CH_3	CH_2CH_3	N
H	CH_3	OCH_3	N
H	CH_2CH_3	CH_3	N
H	CH_2CH_3	CH_2CH_3	N
H	CH_2CH_3	OCH_3	N
H	OCH_3	CH_3	N
H	OCH_3	CH_2CH_3	N
H	OCH_3	OCH_3	N
H	OCH_2CH_3	CH_3	N
H	OCH_2CH_3	CH_2CH_3	N
H	OCH_2CH_3	OCH_3	N
H	$C\equiv CH$	CH_3	N
H	$C\equiv CH$	CH_2CH_3	N
H	$C\equiv CH$	OCH_3	N
H	SCH_3	CH_3	N
H	SCH_3	CH_2CH_3	N
H	SCH_3	OCH_3	N
CH_3	SCH_2CH_3	CH_3	CH
CH_3	SCH_2CH_3	Cl	CH
CH_3	SCH_2CH_3	OCH_3	CH
CH_3	$SOCH_3$	CH_3	CH
CH_3	$SOCH_3$	Cl	CH
CH_3	$SOCH_3$	OCH_3	CH
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CH_3	SO_2CH_3	Cl	CH
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CH_3	$SO_2CH_2CH_3$	Cl	CH
CH_3	$SO_2CH_2CH_3$	OCH_3	CH
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CH_3	SCH_2CH_3	CH_2CH_3	N
CH_3	SCH_2CH_3	OCH_3	N
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CH_3	$SOCH_3$	OCH_3	N
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CH_3	OC_6H_5	CH_2CH_3	N
CH_3	OC_6H_5	OCH_3	N
Na	H	CH_3	CH
Na	H	Cl	CH

R^5	R^2	R^3	Z	R^5	R^2	R^3	Z
Na	H	OCH_3	CH	Na	Cl	CH_2CH_3	N
Na	F	CH_3	CH	Na	Cl	OCH_3	N
Na	F	Cl	CH	Na	CH_3	CH_3	N
Na	F	OCH_3	CH	Na	CH_3	CH_2CH_3	N
Na	Cl	CH_3	CH	Na	CH_3	OCH_3	N
Na	Cl	Cl	CH	Na	CH_2CH_3	CH_3	N
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Na	OCH_3	Cl	CH	Na	C≡CH	CH_3	N
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Na	OCH_2CH_3	CH_3	CH	Na	C≡CH	OCH_3	N
Na	OCH_2CH_3	Cl	CH	Na	SCH_3	CH_3	N
Na	OCH_2CH_3	OCH_3	CH	Na	SCH_3	CH_2CH_3	N
Na	C≡CH	CH_3	CH	Na	SCH_3	OCH_3	N
Na	C≡CH	Cl	CH	Na	SCH_2CH_3	CH_3	CH
Na	C≡CH	OCH_3	CH	Na	SCH_2CH_3	Cl	CH
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Na	SCH_3	Cl	CH	Na	$SOCH_3$	CH_3	CH
Na	SCH_3	OCH_3	CH	Na	$SOCH_3$	Cl	CH
Na	H	CH_3	N	Na	$SOCH_3$	OCH_3	CH
Na	H	CH_2CH_3	N	Na	SO_2CH_3	CH_3	CH
Na	H	OCH_3	N	Na	SO_2CH_3	Cl	CH
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Na	F	CH_2CH_3	N	Na	$SO_2CH_2CH_3$	CH_3	CH
Na	F	OCH_3	N	Na	$SO_2CH_2CH_3$	Cl	CH
Na	Cl	CH_3	N	Na	$SO_2CH_2CH_3$	OCH_3	CH

R^5	R^2	R^3	Z	R^5	R^2	R^3	Z
Na	OC_6H_5	CH_3	CH	$H\cdot NH_2CHMe_2$	CH_2CH_3	OCH_3	CH
Na	OC_6H_5	Cl	CH	$H\cdot NH_2CHMe_2$	OCH_3	CH_3	CH
Na	OC_6H_5	OCH_3	CH	$H\cdot NH_2CHMe_2$	OCH_3	Cl	CH
Na	SCH_2CH_3	CH_3	N	$H\cdot NH_2CHMe_2$	OCH_3	OCH_3	CH
Na	SCH_2CH_3	CH_2CH_3	N	$H\cdot NH_2CHMe_2$	OCH_2CH_3	CH_3	CH
Na	SCH_2CH_3	OCH_3	N	$H\cdot NH_2CHMe_2$	OCH_2CH_3	Cl	CH
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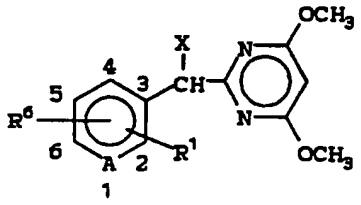
Na	SO_2CH_3	OCH_3	N	$H\cdot NH_2CHMe_2$	SCH_3	Cl	CH
Na	$SO_2CH_2CH_3$	CH_3	N	$H\cdot NH_2CHMe_2$	SCH_3	OCH_3	N
Na	$SO_2CH_2CH_3$	CH_2CH_3	N	$H\cdot NH_2CHMe_2$	H	CH_3	N
Na	$SO_2CH_2CH_3$	OCH_3	N	$H\cdot NH_2CHMe_2$	H	CH_2CH_3	N
Na	OC_6H_5	CH_3	N	$H\cdot NH_2CHMe_2$	H	OCH_3	N
Na	OC_6H_5	CH_2CH_3	N	$H\cdot NH_2CHMe_2$	F	CH_3	N
Na	OC_6H_5	OCH_3	N	$H\cdot NH_2CHMe_2$	F	CH_2CH_3	N
$H\cdot NH_2CHMe_2$	H	CH_3	CH	$H\cdot NH_2CHMe_2$	F	OCH_3	N
$H\cdot NH_2CHMe_2$	H	Cl	CH	$H\cdot NH_2CHMe_2$	Cl	CH_3	N
$H\cdot NH_2CHMe_2$	H	OCH_3	CH	$H\cdot NH_2CHMe_2$	Cl	CH_2CH_3	N
$H\cdot NH_2CHMe_2$	F	CH_3	CH	$H\cdot NH_2CHMe_2$	Cl	OCH_3	N
$H\cdot NH_2CHMe_2$	F	Cl	CH	$H\cdot NH_2CHMe_2$	CH_3	CH_3	N
$H\cdot NH_2CHMe_2$	F	OCH_3	CH	$H\cdot NH_2CHMe_2$	CH_3	CH_2CH_3	N
$H\cdot NH_2CHMe_2$	Cl	CH_3	CH	$H\cdot NH_2CHMe_2$	CH_3	OCH_3	N
$H\cdot NH_2CHMe_2$	Cl	Cl	CH	$H\cdot NH_2CHMe_2$	CH_2CH_3	CH_3	N
$H\cdot NH_2CHMe_2$	Cl	OCH_3	CH	$H\cdot NH_2CHMe_2$	CH_2CH_3	CH_2CH_3	N
$H\cdot NH_2CHMe_2$	CH_3	CH_3	CH	$H\cdot NH_2CHMe_2$	CH_2CH_3	OCH_3	N
$H\cdot NH_2CHMe_2$	CH_3	Cl	CH	$H\cdot NH_2CHMe_2$	OCH_3	CH_3	N
$H\cdot NH_2CHMe_2$	CH_3	OCH_3	CH	$H\cdot NH_2CHMe_2$	OCH_3	CH_2CH_3	N
$H\cdot NH_2CHMe_2$	CH_2CH_3	CH_3	CH	$H\cdot NH_2CHMe_2$	OCH_3	OCH_3	N
$H\cdot NH_2CHMe_2$	CH_2CH_3	Cl	CH	$H\cdot NH_2CHMe_2$	OCH_2CH_3	CH_3	N

R^5	R^2	R^3	Z
$H \cdot NH_2CHMe_2$	OCH_2CH_3	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	OCH_2CH_3	OCH_3	N
$H \cdot NH_2CHMe_2$	$C\equiv CH$	CH_3	N
$H \cdot NH_2CHMe_2$	$C\equiv CH$	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	$C\equiv CH$	OCH_3	N
$H \cdot NH_2CHMe_2$	SCH_3	CH_3	N
$H \cdot NH_2CHMe_2$	SCH_3	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	SCH_3	OCH_3	N
$H \cdot NH_2CHMe_2$	SCH_2CH_3	CH_3	CH
$H \cdot NH_2CHMe_2$	SCH_2CH_3	Cl	CH
$H \cdot NH_2CHMe_2$	SCH_2CH_3	OCH_3	CH
$H \cdot NH_2CHMe_2$	$SOCH_3$	CH_3	CH
$H \cdot NH_2CHMe_2$	$SOCH_3$	Cl	CH
$H \cdot NH_2CHMe_2$	$SOCH_3$	OCH_3	CH
$H \cdot NH_2CHMe_2$	SO_2CH_3	CH_3	CH
$H \cdot NH_2CHMe_2$	SO_2CH_3	Cl	CH
$H \cdot NH_2CHMe_2$	SO_2CH_3	OCH_3	CH
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	CH_3	CH
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	Cl	CH
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	OCH_3	CH
$H \cdot NH_2CHMe_2$	OC_6H_5	CH_3	CH
$H \cdot NH_2CHMe_2$	OC_6H_5	Cl	CH
$H \cdot NH_2CHMe_2$	OC_6H_5	OCH_3	CH
$H \cdot NH_2CHMe_2$	SCH_2CH_3	CH_3	N
$H \cdot NH_2CHMe_2$	SCH_2CH_3	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	SCH_2CH_3	OCH_3	N
$H \cdot NH_2CHMe_2$	$SOCH_3$	CH_3	N
$H \cdot NH_2CHMe_2$	$SOCH_3$	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	$SOCH_3$	OCH_3	N
$H \cdot NH_2CHMe_2$	SO_2CH_3	CH_3	N
$H \cdot NH_2CHMe_2$	SO_2CH_3	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	SO_2CH_3	OCH_3	N
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	CH_3	N
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	$SO_2CH_2CH_3$	OCH_3	N
$H \cdot NH_2CHMe_2$	OC_6H_5	CH_3	N
$H \cdot NH_2CHMe_2$	OC_6H_5	CH_2CH_3	N
$H \cdot NH_2CHMe_2$	OC_6H_5	OCH_3	N
CH_2CF_3	H	CH_3	CH
CH_2CF_3	H	OCH_3	CH
CH_2CF_3	Cl	OCH_3	CH
CH_2CH_2Cl	F	CH_3	CH
CH_2CH_2Cl	F	OCH_3	CH
CH_2CH_2Cl	H	OCH_3	CH
$CH_2CH=CH_2$	Cl	CH_3	CH
$CH_2CH=CH_2$	Cl	OCH_3	CH
$CH_2CH=CH_2$	H	OCH_3	CH
$CH_2C\equiv CH$	CH_3	CH_3	CH
$CH_2C\equiv CH$	CH_3	OCH_3	CH
$CH_2C\equiv CH$	H	OCH_3	CH
CH_2-4-Cl-C_6H_4	CH_2CH_3	CH_3	CH
CH_2-4-Cl-C_6H_4	CH_2CH_3	OCH_3	CH
CH_2-4-Cl-C_6H_4	H	OCH_3	CH
CH_2-2-F-C_6H_4	OCH_3	CH_3	CH
CH_2-2-F-C_6H_4	OCH_3	OCH_3	CH
CH_2-2-F-C_6H_4	H	OCH_3	CH
$CH_2CH_2OCH_3$	OCH_2CH_3	CH_3	CH
$CH_2CH_2OCH_3$	OCH_2CH_3	OCH_3	CH
$CH_2CH_2OCH_3$	H	OCH_3	CH
Li	$C\equiv CH$	CH_3	CH
Li	$C\equiv CH$	OCH_3	CH
Li	H	OCH_3	CH

R^5	R^2	R^3	Z
K	SCH_3	CH_3	CH
K	SCH_3	OCH_3	CH
K	H	OCH_3	CH
CH_2CF_3	H	CH_3	N
CH_2CF_3	H	OCH_3	N
CH_2CF_3	F	OCH_3	N
CH_2CH_2Cl	F	CH_3	N
CH_2CH_2Cl	F	OCH_3	N
CH_2CH_2Cl	H	OCH_3	N
$CH_2CH=CH_2$	Cl	CH_3	N
$CH_2CH=CH_2$	Cl	OCH_3	N
$CH_2CH=CH_2$	Cl	OCH_3	N
$CH_2C\equiv CH$	CH_3	CH_3	N
$CH_2C\equiv CH$	CH_3	OCH_3	N
$CH_2C\equiv CH$	CH_3	OCH_3	N
CH_2-4-Cl-C_6H_4	CH_2CH_3	CH_3	N
CH_2-4-Cl-C_6H_4	CH_2CH_3	OCH_3	N
CH_2-4-Cl-C_6H_4	CH_2CH_3	OCH_3	N
CH_2-2-F-C_6H_4	OCH_3	CH_3	N
CH_2-2-F-C_6H_4	OCH_3	OCH_3	N
CH_2-2-F-C_6H_4	OCH_3	OCH_3	N
$CH_2CH_2OCH_3$	OCH_2CH_3	CH_3	N
$CH_2CH_2OCH_3$	OCH_2CH_3	OCH_3	N
$CH_2CH_2OCH_3$	OCH_2CH_3	OCH_3	N
Li	$C\equiv CH$	CH_3	N
Li	$C\equiv CH$	OCH_3	N
Li	$C\equiv CH$	OCH_3	N
K	SCH_3	CH_3	N
K	SCH_3	OCH_3	N
K	SCH_3	OCH_3	N
$H\cdot NHEt_2$	SCH_2CH_3	CH_3	CH
$H\cdot NHEt_2$	SCH_2CH_3	OCH_3	CH
$H\cdot NHEt_2$	H	OCH_3	CH
$Ca_{1/2}$	SO_2CH_3	CH_3	CH
$Ca_{1/2}$	SO_2CH_3	Cl	CH
$Ca_{1/2}$	H	OCH_3	CH
$H\cdot NHEt_2$	SCH_2CH_3	CH_3	CH
$H\cdot NHEt_2$	SCH_2CH_3	OCH_3	CH
$H\cdot NHEt_2$	SCH_2CH_3	OCH_3	CH
$Ca_{1/2}$	SO_2CH_3	CH_3	CH
$Ca_{1/2}$	SO_2CH_3	CH_2CH_3	CH
$Ca_{1/2}$	SO_2CH_3	OCH_3	CH

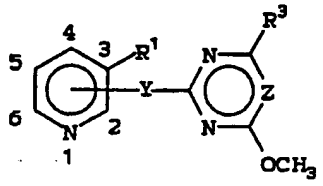
TABLE 3



A	R^6	X	R^1	A	R^6	X	R^1
CH	H	F	2-CO_2H	$COCH_3$	H	F	2-CO_2H
CH	H	F	2-CO_2CH_3	$COCH_3$	H	F	2-CO_2CH_3
CH	H	F	2-CO_2CH_2Ph	$COCH_3$	H	F	2-CO_2CH_2Ph
CH	H	Cl	2-CO_2H	$COCH_3$	H	Cl	2-CO_2H
CH	H	Cl	2-CO_2CH_3	$COCH_3$	H	Cl	2-CO_2CH_3
CH	H	Cl	2-CO_2CH_2Ph	$COCH_3$	H	Cl	2-CO_2CH_2Ph
CH	H	CH_3	2-CO_2H	$COCH_3$	H	CH_3	2-CO_2H
CH	H	CH_3	2-CO_2CH_3	$COCH_3$	H	CH_3	2-CO_2CH_3
CH	H	CH_3	2-CO_2CH_2Ph	$COCH_3$	H	CH_3	2-CO_2CH_2Ph
CCH_3	H	F	2-CO_2H	CCl	H	F	2-CO_2H
CCH_3	H	F	2-CO_2CH_3	CCl	H	F	2-CO_2CH_3
CCH_3	H	F	2-CO_2CH_2Ph	CCl	H	F	2-CO_2CH_2Ph
CCH_3	H	Cl	2-CO_2H	CCl	H	Cl	2-CO_2H
CCH_3	H	Cl	2-CO_2CH_3	CCl	H	Cl	2-CO_2CH_3
CCH_3	H	Cl	2-CO_2CH_2Ph	CCl	H	Cl	2-CO_2CH_2Ph
CCH_3	H	CH_3	2-CO_2H	CCl	H	CH_3	2-CO_2H
CCH_3	H	CH_3	2-CO_2CH_3	CCl	H	CH_3	2-CO_2CH_3
CCH_3	H	CH_3	2-CO_2CH_2Ph	CCl	H	CH_3	2-CO_2CH_2Ph

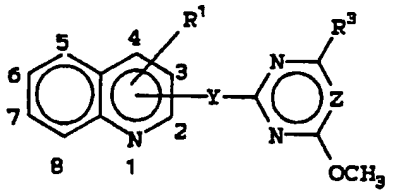
A	R^6	X	R^1	A	R^6	X	R^1
N	H	F	2-CO_2H	N	H	F	4-CO_2H
N	H	F	2-CO_2CH_3	N	H	F	4-CO_2CH_3
N	H	F	2-CO_2CH_2Ph	N	H	F	4-CO_2CH_2Ph
N	H	Cl	2-CO_2H	N	H	Cl	4-CO_2H
N	H	Cl	2-CO_2CH_3	N	H	Cl	4-CO_2CH_3
N	H	Cl	2-CO_2CH_2Ph	N	H	Cl	4-CO_2CH_2Ph
N	H	CH_3	2-CO_2H	N	H	CH_3	4-CO_2H
N	H	CH_3	2-CO_2CH_3	N	H	CH_3	4-CO_2CH_3
N	H	CH_3	2-CO_2CH_2Ph	N	H	CH_3	4-CO_2CH_2Ph
N	4-F	F	2-CO_2H	N	2-F	F	4-CO_2H
N	4-F	F	2-CO_2CH_3	N	2-F	F	4-CO_2CH_3
N	4-F	F	2-CO_2CH_2Ph	N	2-F	F	4-CO_2CH_2Ph
N	5-OCH_3	CH_3	2-CO_2H	N	5-OCH_3	CH_3	4-CO_2H
N	5-OCH_3	CH_3	2-CO_2CH_3	N	5-OCH_3	CH_3	4-CO_2CH_3
N	5-OCH_3	CH_3	2-CO_2CH_2Ph	N	5-OCH_3	CH_3	4-CO_2CH_2Ph
N	6-SCH_3	Cl	2-CO_2H	N	6-SCH_3	Cl	4-CO_2H
N	6-SCH_3	Cl	2-CO_2CH_3	N	6-SCH_3	Cl	4-CO_2CH_3
N	6-SCH_3	Cl	2-CO_2CH_2Ph	N	6-SCH_3	Cl	4-CO_2CH_2Ph
N	H	CN	2-CO_2H	N	H	CN	4-CO_2H

TABLE 4



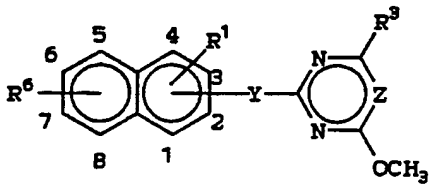
Y	R^1	R^3	Z	Y	R^1	R^3	Z
2-CH_2	CO_2H	OCH_3	CH	4-CH_2	CO_2H	OCH_3	CH
2-CH_2	CO_2CH_3	OCH_3	CH	4-CH_2	CO_2CH_3	OCH_3	CH
2-CH_2	$CO_2CH_2C_6H_5$	OCH_3	CH	4-CH_2	$CO_2CH_2C_6H_5$	OCH_3	CH
2-CH_2	CO_2H	CH_3	CH	4-CH_2	CO_2H	CH_3	CH
2-CH_2	CO_2H	CH_3	N	4-CH_2	CO_2H	CH_3	N
2-CHCN	CO_2H	OCH_3	CH	4-CHCN	CO_2H	OCH_3	CH
2-CHCN	CO_2CH_3	OCH_3	CH	4-CHCN	CO_2CH_3	OCH_3	CH
2-CHCN	$CO_2CH_2C_6H_5$	OCH_3	CH	4-CHCN	$CO_2CH_2C_6H_5$	OCH_3	CH
2-CHCN	CO_2H	CH_3	CH	4-CHCN	CO_2H	CH_3	CH
2-CHCN	CO_2H	CH_3	N	4-CHCN	CO_2H	CH_3	N

TABLE 5



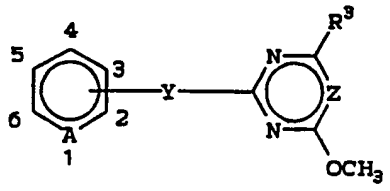
Y	R^1	R^3	Z	Y	R^1	R^3	Z
2-CH_2	3-CO_2H	OCH_3	CH	3-CH_2	4-CO_2H	OCH_3	CH
2-CH_2	3-CO_2CH_3	OCH_3	CH	3-CH_2	4-CO_2CH_3	OCH_3	CH
2-CH_2	3-$CO_2CH_2C_6H_5$	OCH_3	CH	3-CH_2	4-$CO_2CH_2C_6H_5$	OCH_3	CH
2-CH_2	3-CO_2H	CH_3	CH	3-CH_2	4-CO_2H	CH_3	CH
2-CH_2	3-CO_2H	CH_3	N	3-CH_2	4-CO_2H	CH_3	N
2-CHCN	3-CO_2H	OCH_3	CH	3-CHCN	4-CO_2H	OCH_3	CH
2-CHCN	3-CO_2CH_3	OCH_3	CH	3-CHCN	4-CO_2CH_3	OCH_3	CH
2-CHCN	3-$CO_2CH_2C_6H_5$	OCH_3	CH	3-CHCN	4-$CO_2CH_2C_6H_5$	OCH_3	CH
2-CHCN	3-CO_2H	CH_3	CH	3-CHCN	4-CO_2H	CH_3	CH
2-CHCN	3-CO_2H	CH_3	N	3-CHCN	4-CO_2H	CH_3	N
6-CH_2	5-CO_2H	OCH_3	CH	7-CH_2	8-CO_2H	OCH_3	CH
6-CH_2	5-CO_2CH_3	OCH_3	CH	7-CH_2	8-CO_2CH_3	OCH_3	CH
6-CH_2	5-$CO_2CH_2C_6H_5$	OCH_3	CH	7-CH_2	8-$CO_2CH_2C_6H_5$	OCH_3	CH
6-CH_2	5-CO_2H	CH_3	CH	7-CH_2	8-CO_2H	CH_3	CH
6-CH_2	5-CO_2H	CH_3	N	7-CH_2	8-CO_2H	CH_3	N
6-CHCN	5-CO_2H	OCH_3	CH	7-CHCN	8-CO_2H	OCH_3	CH
6-CHCN	5-CO_2CH_3	OCH_3	CH	7-CHCN	8-CO_2CH_3	OCH_3	CH
6-CHCN	5-$CO_2CH_2C_6H_5$	OCH_3	CH	7-CHCN	8-$CO_2CH_2C_6H_5$	OCH_3	CH
6-CHCN	5-CO_2H	CH_3	CH	7-CHCN	8-CO_2H	CH_3	CH
6-CHCN	5-CO_2H	CH_3	N	7-CHCN	8-CO_2H	CH_3	N

TABLE 6



Y	R^1	R^3	R^6	Z
2-CH_2	1-CHO	OCH_3	H	CH
2-CH_2	1-CO_2H	OCH_3	8-Cl	CH
2-CH_2	1-CO_2H	CH_3	H	CH
2-CH_2	1-CO_2H	OCH_3	H	CH
2-CH_2	1-CO_2CH_3	CH_3	H	N
2-CH_2	1-CO_2CH_3	OCH_3	H	CH
2-CH(OH)	1-CHO	OCH_3	H	CH
2-CH(OH)	1-CO_2H	OCH_3	H	CH
2-CH(OH)	1-CO_2H	CH_3	H	N
2-CH(OH)	1-CO_2CH_3	OCH_3	H	CH
2-CH(OH)	1-$CO_2CH_2C_6H_5$	OCH_3	H	CH
2-CHCl	1-CHO	OCH_3	H	CH
2-CHCl	1-CO_2H	OCH_3	H	CH
2-CHCl	1-CO_2H	CH_3	H	CH
2-CHCl	1-CO_2CH_3	OCH_3	H	N
2-CHCl	1-CO_2CH_3	OCH_3	H	CN
2-CHCN	1-CHO	OCH_3	H	CH
2-CHCN	1-CO_2H	OCH_3	H	CH
2-CHCN	1-CO_2H	OCH_3	6-Cl	CH
2-CHCN	1-CO_2Na	OCH_3	H	CH
2-CHCN	1-CO_2Na	OCH_3	H	N

TABLE 7



A	Y	R^3	Z	A	Y	R^3	Z
CH	2-$CHCO_2CH_3$	OCH_3	CH	N	2-$CHCO_2CH_3$	OCH_3	CH
CH	2-$CHCO_2CH_2CH_3$	OCH_3	CH	N	2-$CHCO_2CH_2CH_3$	OCH_3	CH
CH	2-$CHCO_2CH_2CH_3$	CH_3	CH	N	2-$CHCO_2CH_2CH_3$	CH_3	CH
CH	2-$CHCO_2CH_2CH_3$	CH_3	N	N	2-$CHCO_2CH_2CH_3$	CH_3	N
CH	2-$CHCO_2CH_2CH_3$	$N(CH_3)_2$	CH	N	2-$CHCO_2CH_2CH_3$	$N(CH_3)_2$	CH
CH	2-$CHCO_2CH_2CH_2CH_3$	OCH_3	CH	N	2-$CHCO_2CH_2CH_2CH_3$	OCH_3	CH
CH	2-$CHCO_2CH_2C_6H_4$	OCH_3	CH	N	2-$CHCO_2CH_2C_6H_4$	OCH_3	CH
CH	2-$CHCO_2CH_2C_6H_4$	CH_3	N	N	2-$CHCO_2CH_2C_6H_4$	CH_3	N
CH	2-$CHCO_2CH_2CH{=}CH_2$	CH_3	CH	N	2-$CHCO_2CH_2CH{=}CH_2$	CH_3	CH
CH	2-$CHCO_2CH_2CH{=}CH_2$	OCH_3	CH	N	2-$CHCO_2CH_2CH{=}CH_2$	OCH_3	CH
CH	2-$CHCO_2CH_2C{\equiv}CH$	OCH_3	CH	N	2-$CHCO_2CH_2C{\equiv}CH$	OCH_3	CH
C-CH_3	2-$CO_2CH_2CH_3$	OCH_3	CH	N-O	2-$CO_2CH_2CH_3$	OCH_3	CH
C-OCH_3	3-$CO_2CH_2CH_3$	OCH_3	CH	N-O	3-$CO_2CH_2CH_3$	OCH_3	CH
C-Cl	3-$CO_2CH_2CH_3$	OCH_3	CH	N-O	3-$CO_2CH_2CH_3$	OCH_3	CH
C-F	3-$CO_2CH_2CH_3$	OCH_3	CH				

Formulations

Useful formulations of the compounds of Formula I can be prepared in conventional ways. They include dusts, granules, pellets, solutions, suspensions, emulsions, wettable powders, emulsifiable concentrates and the like. Many of these may be applied directly. Sprayable formulations can be extended in suitable media and used at spray volumes of from a few liters to several hundred liters per hectare. High strength compositions are primarily used as intermediates for further formulation. The formulations, broadly, contain about 0.1% to 99% by weight of active ingredient(s) and at least one of (a) about 0.1% to 20% surfactant(s) and (b) about 1% to 99.9% solid or liquid diluent(s). More specifically, they will contain these ingredients in the following approximate proportions:

Table 8

	Weight Percent*		
	Active Ingredient	Diluent(s)	Surfactant(s)
Wettable Powders	20-90	0-74	1-10
Oil Suspensions, Emulsions, Solutions, (including Emulsifiable Concentrates)	3-50	40-95	0-15
Aqueous Suspension	10-50	40-84	1-20
Dusts	1-25	70-99	0-5
Granules and Pellets	0.1-95	5-99.9	0-15
High Strength Compositions	90-99	0-10	0-2

* Active ingredient plus at least one of a Surfactant or a Diluent equals 100 weight percent.

Lower or higher levels of active ingredient can, of course, be present depending on the intended use and the physical properties of the compound. Higher ratios of surfactant to active ingredient are sometimes desirable, and are achieved by incorporation into the formulation or by tank mixing.

Typical solid diluents are described in Watkins, et al., "Handbook of Insecticide Dust Diluents and Carriers", 2nd Ed., Dorland Books, Caldwell, New Jersey, but other solids, either mined or manufactured, may be used. The more absorptive diluents are preferred for wettable powders and the denser ones for dusts. Typical liquid diluents and solvents are described in Marsden, "Solvents Guide," 2nd Ed., Interscience, New York, 1950. Solubility under 0.1% is preferred for suspension concentrates; solution concentrates are preferably stable against phase separation at 0°C. "McCutcheon's Detergents and Emulsifiers Annual", MC Publishing Corp., Ridgewood, New Jersey, as well as Sisely and Wood, "Encyclopedia of Surface Active Agents", Chemical Publishing Co., Inc., New York, 1964, list surfactants and recommended uses. All formulations can contain minor amounts of additives to reduce foaming, caking, corrosion, microbiological growth, etc.

The methods of making such compositions are well known. Solutions are prepared by simply mixing the ingredients. Fine solid compositions are made by blending and, usually, grinding as in a hammer or fluid energy mill. Suspensions are prepared by wet milling (see, for example, Littler, U.S. Patent 3,060,084). Granules and pellets may be made by spraying the active material upon preformed granular carriers or by agglomeration techniques. See J. E.

Browning, "Agglomeration", Chemical Engineering, December 4, 1967, pp. 147ff. and "Perry's Chemical Engineer's Handbook", 5th Ed., McGraw-Hill, New York, 1973, pp. 8-57ff.

For further information regarding the art of formulation, see for example:

H. M. Loux, U.S. Patent 3,235,361, February 15, 1966, Col. 6, line 16 through Col. 7, line 19 and Examples 10 through 41;

R. W. Luckenbaugh, U.S. Patent 3,309,192, March 14, 1967, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138-140, 162-164, 166, 167 and 169-182;

H. Gysin and E. Knusli, U.S. Patent 2,891,855, June 23, 1959, Col. 3, line 66 through Col. 5, line 17 and Examples 1-4;

G. C. Klingman, "Weed Control as a Science", John Wiley and Sons, Inc., New York, 1961, pp. 81-96; and

J. D. Fryer and S. A. Evans, "Weed Control Handbook", 5th Ed., Blackwell Scientific Publications, Oxford, 1968, pp. 101-103.

In the following examples, all parts are by weight unless otherwise indicated.

Example A

Wettable Powder

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	80%
sodium alkylnaphthalenesulfonate	2%
sodium ligninsulfonate	2%
synthetic amorphous silica	3%
kaolinite	13%

The ingredients are blended, hammer-milled until all the solids are essentially under 50 microns, reblended, and packaged.

Example B

Wettable Powder

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	50%
sodium alkylnaphthalenesulfonate	2%
low viscosity methyl cellulose	2%
diatomaceous earth	46%

The ingredients are blended, coarsely hammer-milled and then air-milled to produce particles essentially all below 10 microns in diameter. The product is reblended before packaging.

Example C

Granule

Wettable Powder of Example B	5%
attapulgite granules (U.S.S. 20-40 mesh; 0.84-0.42 mm)	95%

A slurry of wettable powder containing 25% solids is sprayed on the surface of attapulgite granules in a double-cone blender. The granules are dried and packaged.

Example D

Extruded Pellet

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	25%
anhydrous sodium sulfate	10%
crude calcium ligninsulfonate	5%
sodium alkylnaphthalenesulfonate	1%
calcium/magnesium bentonite	59%

The ingredients are blended, hammer-milled and then moistened with about 12% water. The mixture is extruded as cylinders about 3 mm diameter which are cut to produce pellets about 3 mm long. These may be

used directly after drying, or the dried pellets may be crushed to pass a U.S.S. No. 20 sieve (0.84 mm openings). The granules held on a U.S.S. No. 40 sieve (0.42 mm openings) may be packaged for use and the fines recycled.

Example E

Oil Suspension

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	25%
polyoxyethylene sorbitol hexaoleate	5%
highly aliphatic hydrocarbon oil	70%

The ingredients are ground together in a sand mill until the solid particles have been reduced to under about 5 microns. The resulting thick suspension may be applied directly, but preferably after being extended with oils or emulsified in water.

Example F

Wettable Powder

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	20%
sodium alkylnaphthalenesulfonate	4%
sodium ligninsulfonate	4%
low viscosity methyl cellulose	3%
attapulgite	69%

The ingredients are thoroughly blended. After grinding in a hammer-mill to produce particles essentially all below 100 microns, the material is reblended and sifted through a U.S.S. No. 50 sieve (0.3 mm opening) and packaged.

Example G

Low Strength Granule

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	1%
N,N-dimethylformamide	9%
attapulgite granules (U.S.S. 20-40 sieve)	90%

The active ingredient is dissolved in the solvent and the solution is sprayed upon dedusted granules in a double cone blender. After spraying of the solution has been completed, the blender is allowed to run for a short period and then the granules are packaged.

Example H

Aqueous Suspension

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	40%
polyacrylic acid thickener	0.3%
dodecylphenol polyethylene glycol ether	0.5%
disodium phosphate	1%
monosodium phosphate	0.5%
polyvinyl alcohol	1.0%
water	56.7%

The ingredients are blended and ground together in a sand mill to produce particles essentially all under 5 microns in size.

Example I

Solution

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	5%
water	95%

The salt is added directly to the water with stirring to produce the solution, which may then be packaged for use.

Example J

Low Strength Granule

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	0.1%
attapulgite granules (U.S.S. 20-40 mesh)	99.9%

The active ingredient is dissolved in a solvent and the solution is sprayed upon dedusted granules in a double-cone blender. After spraying of the solution has been completed, the material is warmed to evaporate the solvent. The material is allowed to cool and then packaged.

Example K

Granule

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	80%
wetting agent	1%
crude ligninsulfonate salt (containing 5-20% of the natural sugars)	10%
attapulgite clay	9%

The ingredients are blended and milled to pass through a 100 mesh screen. This material is then added to a fluid bed granulator, the air flow is adjusted to gently fluidize the material, and a fine spray of water is sprayed onto the fluidized material. The fluidization and spraying are continued until granules of the desired size range are made. The spraying is stopped, but fluidization is continued, optionally with heat, until the water content is reduced to the desired level, generally less than 1%. The material is then discharged, screened to the desired size range, generally 14-100 mesh (1410-149 microns), and packaged for use.

Example L

High Strength Concentrate

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	99%
silica aerogel	0.5%
synthetic amorphous silica	0.5%

The ingredients are blended and ground in a hammer-mill to produce a material essentially all passing a U.S.S. No. 50 screen (0.3 mm opening). The concentrate may be formulated further if necessary.

Example M

Wettable Powder

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	90%
dioctyl sodium sulfosuccinate	0.1%
synthetic fine silica	9.9%

The ingredients are blended and ground in a hammer-mill to produce particles essentially all below 100 microns. The material is sifted through a U.S.S. No. 50 screen and then packaged.

Example N

Wettable Powder

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	40%
sodium ligninsulfonate	20%
montmorillonite clay	40%

The ingredients are thoroughly blended, coarsely hammer-milled and then air-milled to produce particles essentially all below 10 microns in size. The material is reblended and then packaged.

Example O

Oil Suspension

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	35%
blend of polyalcohol carboxylic esters and oil soluble petroleum sulfonates	6%
xylene	59%

The ingredients are combined and ground together in a sand mill to produce particles essentially all below 5 microns. The product can be used directly, extended with oils, or emulsified in water.

Example P

Dust

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	10%
attapulgite	10%
Pyrophyllite	80%

The active ingredient is blended with attapulgite and then passed through a hammer-mill to produce particles substantially all below 200 microns. The ground concentrate is then blended with powdered pyrophyllite until homogeneous.

Example Q

Emulsifiable Concentrate

2-[4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid	10%
chlorobenzene	84%
sorbitan monostearate and polyoxyethylene condensates thereof	6%

The ingredients are combined and stirred to produce a solution which can be emulsified in water for application.

Utility

Test results indicate that compounds of this invention are active postemergence and preemergence herbicides. These compounds are useful for the control of selected grass and broadleaf weeds with tolerance to important agronomic crops which include, but are not limited to barley (Hordeum vulgare), corn (Zea mays), cotton (Gossypium hirsutum), and wheat (Triticum aestivum). Weed species controlled include, but are not limited to cocklebur (Xanthium pensylvanicum), teaweed (Sida spinosa), and velvetleaf (Abutilon theophrasti).

These compounds also have utility for complete control and/or selected control of vegetation in specified areas such as around storage tanks, parking lots, highways, and railways, and in fallow crop, citrus, and plantation crop areas. Alternatively, these compounds are useful to modify plant growth.

A herbicidally effective amount of the compounds of this invention is determined by a number of factors. These factors include: formulation selected, method of application, amount and type of vegetation present, growing conditions, etc. In general terms, a herbicidally effective amount of the compounds of the invention is applied at rates from 0.004 to 20 kg/ha with a preferred rate range of 0.025 to 2 kg/ha. One skilled in the art can easily determine the application rate needed for the desired level of weed control.

Compounds of this invention may be used alone or in combination with other commercial herbicides, insecticides, or fungicides. The following list exemplifies some of the herbicides suitable for use in mixtures. A combination of a compound from this invention with one or more of the following herbicides may be particularly useful for weed control.

Common Name	Chemical Name
acetochlor	2-chloro-N-(ethoxymethyl)-N-(2-ethyl-6-methylphenyl)acetamide
acifluorfen	5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoic acid
acrolein	2-propenal
alachlor	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide
anilofos	S-4-chloro-N-isopropylcarbaniloyl-methyl-O,O-dimethyl phosphorodithioate
ametryn	N-ethyl-N'-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
amitrole	1H-1,2,4-triazol-3-amine
AMS	ammonium sulfamate
asulam	methyl [(4-aminophenyl)sulfonyl]-carbamate
atrazine	6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine
barban	4-chloro-2-butynyl 3-chlorocarbamate
benefin	N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine
bensulfuron methyl	2-[[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]methylcarbonyl]-amino]sulfonyl]methyl]benzoic acid, methyl ester
bensulide	O,O-bis(1-methylethyl) S-[2-[(phenylsulfonyl)amino]-ethyl]phosphorodithioate
bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one, 2,2-dioxide
benzofluor	N-[4-(ethylthio)-2-(trifluoromethyl)phenyl]methanesulfonamide

Common Name	Chemical Name
benzoylprop	N-benzoyl-N-(3,4-dichlorophenyl)-DL-alanine
bifenox	methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate
bromacil	5-bromo-6-methyl-3-(1-methylpropyl)-2,4(1H,3H)pyrimidinedione
bromoxynil	3,5-dibromo-4-hydroxybenzonitrile
butachlor	N-(butoxymethyl)-2-chloro-N-(2,6-diethylphenyl)acetamide
buthidazole	3-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-4-hydroxy-1-methyl-2-imidazolidinone
butralin	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine
butylate	S-ethyl bis(2-methylpropyl)-carbamothioate
cacodylic acid	dimethyl arsinic oxide
CDAA	2-chloro-N,N-di-2-propenylacetamide
CDEC	2-chloroallyl diethyldithiocarbamate
CGA 142,464	3-(4,6-dimethoxy-1,3,5-triazin-2-yl)-1-[2-(2-methoxyethoxy)-phenylsulfonyl]-urea
chloramben	3-amino-2,5-dichlorobenzoic acid
chlorbromuron	3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea
chlorimuron ethyl	2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)ethylamino]carbonyl]-amino]sulfonyl]benzoic acid, ethyl ester
chlormethoxynil	2,4-dichlorophenyl 4-nitro-3-methoxyphenyl ether
chlornitrofen	2,4,6-trichlorophenyl-4-nitrophenyl ether

Common Name	Chemical Name
chloroxuron	N'-[4-(4-chlorophenoxy)phenyl]-N,N-dimethylurea
chlorpropham	1-methylethyl 3-chlorophenylcarbamate
chlorsulfuron	2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide
chlortoluron	N'-(3-chloro-4-methylphenyl)-N,N-dimethylurea
cinmethylin	exo-1-methyl-4-(1-methylethyl)-2-[(2-methylphenyl)methoxy]-7-oxabicyclo-[2.2.1]heptane
clethodim	(E,E)-(±)-2-[1-[[(3-chloro-2-propenyl)-oxy]imino]propyl]-5-[2-(ethylthio)-propyl]-3-hydroxy-2-cyclohexen-1-one
clomazone	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone
cloproxydim	(E,E)-2-[1-[[(3-chloro-2-propenyl)oxy)-imino]butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
clopyralid	3,6-dichloro-2-pyridinecarboxylic acid
CMA	calcium salt of MAA
cyanazine	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methylpropanenitrile
cycloate	S-ethyl cyclohexylethylcarbamothioate
cycluron	3-cyclooctyl-1,1-dimethylurea
cyperquat	1-methyl-4-phenylpyridinium
cyprazine	2-chloro-4-(cyclopropylamino)-6-(isopropylamino)-s-triazine
cyprazole	N-[5-(2-chloro-1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]cyclopropanecarboxamide
cypromid	3',4'-dichlorocyclopropanecarboxanilide

Common Name	Chemical Name
dalapon	2,2-dichloropropanoic acid
dazomet	tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione
DCPA	dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate
desmediphan	ethyl [3-[[(phenylamino)carbonyl]oxy]-phenyl]carbamate
desmetryn	2-(isopropylamino)-4-(methylamino)-6-(methylthio)-s-triazine
diallate	S-(2,3-dichloro-2-propenyl)bis(1-methylethyl)carbamothioate
dicamba	3,6-dichloro-2-methoxybenzoic acid
dichlobenil	2,6-dichlorobenzonitrile
dichlorprop	(±)-2-(2,4-dichlorophenoxy)propanoic acid
diclofop-methyl	(±)-2-[4-(2,4-dichlorophenoxy)phenoxy]-propanoic acid, methyl ester
diethatyl	N-(chloroacetyl)-N-(2,6-diethylphenyl)-glycine
difenzoquat	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium
dimepiperate	S-1-methyl-1-phenylethylpiperidine-1-carbothioate
dinitramine	N^3,N^3-diethyl-2,4-dinitro-6-(trifluoromethyl)-1,3-benzenediamine
dinoseb	2-(1-methylpropyl)-4,6-dinitrophenol
diphenamid	N,N-dimethyl-α-phenylbenzeneacetamide
dipropetryn	6-(ethylthio)-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine
diquat	6,7-dihydrodipyrido[1,2-a:2',1'-c]-pyrazinedium ion
diuron	N'-(3,4-dichlorophenyl)-N,N-dimethylurea

Common Name	Chemical Name
DNOC	2-methyl-4,6-dinitrophenol
DSMA	disodium salt of MAA
dymron	N-(4-methylphenyl)-N'-(1-methyl-1-phenylethyl)urea
endothall	7-oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
EPTC	S-ethyl dipropylcarbamothioate
esprocarb (SC2957)	S-benzyl-N-ethyl-N-(1,2-dimethyl)-propyl)thiolcarbamate
ethalfluralin	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)-benzenamine
ethofumesate	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate
fenac	2,3,6-trichlorobenzeneacetic acid
fenoxaprop	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]-phenoxy]propanoic acid
fenuron	N,N-dimethyl-N'-phenylurea
fenuron TCA	Salt of fenuron and TCA
flamprop	N-benzoyl-N-(3-chloro-4-fluorophenyl)-DL-alanine
fluazifop	(±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid
fluazifop-P	(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid
fluchloralin	N-(2-chloroethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)benzenamine
fluometuron	N,N-dimethyl-N'-[3-(trifluoromethyl)-phenyl]urea

Common Name	Chemical Name
fluorochloridone	3-chloro-4-(chloromethyl)-1-[3-(trifluoromethyl)phenyl]-2-pyrrolidinone
fluorodifen	p-nitrophenyl α,α,α-trifluoro-2-nitro-p-tolyl ether
fluoroglycofen	carboxymethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate
fluridone	1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone
fomesafen	5-[2-chloro-4-(trifluoromethyl)phenoxy]-N-(methylsulfonyl)-2-nitrobenzamide
fosamine	ethyl hydrogen (aminocarbonyl)-phosphate
glyphosate	N-(phosphonomethyl)glycine
haloxyfop	2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid
hexaflurate	potassium hexafluoroarsenate
hexazinone	3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione
imazamethabenz	6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluic acid, methyl ester and 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluic acid, methyl ester
imazapyr	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
imazaquin	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinolinecarboxylic acid
imazethapyr	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid

Common Name	Chemical Name
ioxynil	4-hydroxy-3,5-diiodobenzonitrile
isopropalin	4-(1-methylethyl)-2,6-dinitro-N,N-dipropylbenzenamine
isoproturon	N-(4-isopropylphenyl)-N',N'-dimethylurea
isouron	N'-[5-(1,1-dimethylethyl)-3-isoxazolyl]-N,N-dimethylurea
isoxaben	N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide
karbutilate	3-[[(dimethylamino)carbonyl]amino]-phenyl-(1,1-dimethylethyl)carbamate
lactofen	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate
lenacil	3-cyclohexyl-6,7-dihydro-1H-cyclopenta-pyrimidine-2,4(3H,5H)-dione
linuron	N'-(3,4-dichlorophenyl)-N-methoxy-N-methylurea
MAA	methylarsonic acid
MAMA	monoammonium salt of MAA
MCPA	(4-chloro-2-methylphenoxy)acetic acid
MCPB	4-(4-chloro-2-methylphenoxy)butanoic acid
MON 7200	S,S-dimethyl-2-(difluoromethyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3,5-pyridinedicarbothionate
mecoprop	(±)-2-(4-chloro-2-methylphenoxy)-propanoic acid
mefenacet	2-(2-benzothiazolyloxy-N-methyl-N-phenylacetamide
mefluidide	N-[2,4-dimethyl-5-[[(trifluoromethyl)-sulfonyl]amino]phenyl]acetamide
methal-propalin	N-(2-methyl-2-propenyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)benzenamide

Common Name	Chemical Name
methabenz-thiazuron	1,3-dimethyl-3-(2-benzothiazolyl)urea
metham	methylcarbamodithioic acid
methazole	2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione
methoxuron	N'-(3-chloro-4-methoxyphenyl)-N,N-dimethylurea
metolachlor	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide
metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one
metsulfuron methyl	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]-amino]sulfonyl]benzoic acid, methyl ester
MH	1,2-dihydro-3,6-pyridazinedione
molinate	S-ethyl hexahydro-1H-azepine-1-carbothioate
monolinuron	3-(p-chlorophenyl)-1-methoxy-1-methylurea
monuron	N'-(4-chlorophenyl)-N,N-dimethylurea
monuron TCA	Salt of monuron and TCA
MSMA	monosodium salt of MAA
napropamide	N,N-diethyl-2-(1-naphthalenyloxy)-propanamide
naptalam	2-[(1-naphthalenylamino)carbonyl]-benzoic acid
neburon	1-butyl-3-(3,4-dichlorophenyl)-1-methylurea
nitralin	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline
nitrofen	2,4-dichloro-1-(4-nitrophenoxy)benzene

Common Name	Chemical Name
nitrofluorfen	2-chloro-1-(4-nitrophenoxy)-4-(trifluoromethyl)benzene
norea	N,N-dimethyl-N'-(octahydro-4,7-methano-1H-inden-5-yl)urea 3aα,4α,5α,7α,7aα-isomer
norflurazon	4-chloro-5-(methylamino)-2-[3-(trifluoromethyl)phenyl]-3(2H)-pyridazinone
oryzalin	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide
oxadiazon	3-[2,4-dichloro-5-(1-methylethoxy)-phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2(3H)-one
oxyfluorfen	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene
paraquat	1,1'-dimethyl-4,4'-dipyridinium ion
pebulate	S-propyl butylethylcarbamothioate
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
perfluidone	1,1,1-trifluoro-N-[2-methyl-4-(phenylsulfonyl)phenyl]methanesulfonamide
phenmedipham	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate
picloram	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid
PPG-1013	5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitroacetophenone oxime-O-acetic acid, methyl ester
pretilachlor	α-chloro-2,6-diethyl-N-(2-propoxyethyl)acetanilide
procyazine	2-[[4-chloro-6-(cyclopropylamino)-1,3,5-triazine-2-yl]amino]-2-methylpropanenitrile
profluralin	N-(cyclopropylmethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)benzenamine

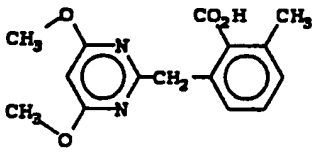
Common Name	Chemical Name
prometon	6-methoxy-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine
prometryn	N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
pronamide	3,5-dichloro-N-(1,1-dimethyl-2-propynyl)benzamide
propachlor	2-chloro-N-(1-methylethyl)-N-phenylacetamide
propanil	N-(3,4-dichlorophenyl)propanamide
propazine	6-chloro-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine
propham	1-methylethyl phenylcarbamate
prosulfalin	N-[[4-(dipropylamino)-3,5-dinitrophenyl]sulfonyl]-S,S-dimethylsulfilimine
prynachlor	2-chloro-N-(1-methyl-2-propynyl)acetanilide
pyrazolate	4-(2,4-dichlorobenzoyl)-1,3-dimethylpyrazol-5-yl-p-toluenesulphonate
pyrazon	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
pyrazosulfuron ethyl	ethyl S-[3-(4,6-dimethoxypyrimidin-2-yl)ureadosulfonyl]-1-methylpyrazole-4-carboxylate
quinclorac	3,7-dichloro-8-quinoline carboxylic acid
quizalofop ethyl	(±)-2-[4-[(6-chloro-2-quinoxalinyl)-oxy]phenoxy]propanoic acid, ethyl ester
secbumeton	N-ethyl-6-methoxy-N'-(1-methylpropyl)-1,3,5-triazine-2,4-diamine
sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
siduron	N-(2-methylcyclohexyl)-N'-phenylurea

Common Name	Chemical Name
simazine	6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine
SK-233	1-(α,α-dimethylbenzyl)-3-(4-methylphenyl)urea
sulfometuron methyl	2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-benzoic acid, methyl ester
TCA	trichloroacetic acid
tebuthiuron	N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea
terbacil	5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione
terbuchlor	N-(butoxymethyl)-2-chloro-N-[2-(1,1-dimethylethyl)-6-methylphenyl]-acetamide
terbuthylazine	2-(tert-butylamino)-4-chloro-6-(ethylamino)-s-triazine
terbutol	2,6-di-tert-butyl-p-tolyl methylcarbamate
terbutryn	N-(1,1-dimethylethyl)-N'-ethyl-6-(methylthio)-1,3,5-triazine-2,4-diamine
thifensulfuron methyl	3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid, methyl ester
thiobencarb	S-[(4-chlorophenyl)methyl] diethylcarbamothioate
triallate	S-(2,3,3-trichloro-2-propenyl) bis(1-methylethyl)carbamothioate
tribenuron methyl	2-[[[[N-(4-methoxy-6-methyl-1,3,5-triazine-2-yl)-N-methylamino]-carbonyl]amino]sulfonyl]benzoic acid, methyl ester

Common Name	Chemical Name
triclopyr	[(3,5,6-trichloro-2-pyridinyl)-oxy]acetic acid
tridiphane	2-(3,5-dichlorophenyl)-2-(2,2,2-trichloroethyl)oxirane
trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine
trimeturon	1-(p-chlorophenyl)-2,3,3-trimethylpseudourea
2,4-D	(2,4-dichlorophenoxy)acetic acid
2,4-DB	4-(2,4-dichlorophenoxy)butanoic acid
vernolate	S-propyl dipropylcarbamothioate
xylachlor	2-chloro-N-(2,3-dimethylphenyl)-N-(1-methylethyl)acetamide

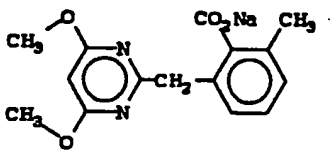
Herbicidal properties of the compounds that follow were determined in greenhouse tests. Test results and procedures follow.

TABLE OF COMPOUNDS



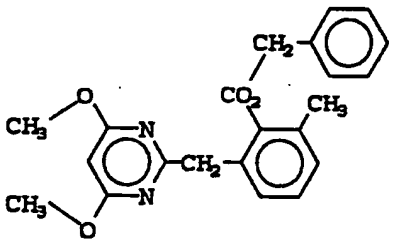
Compound 1

m p. 122-124°C



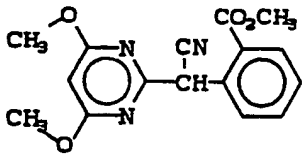
Compound 2

m p. 180-190°C



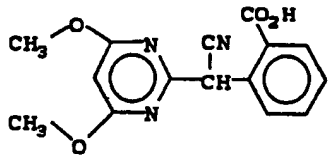
Compound 3

Oil

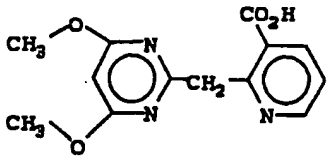


Compound 4

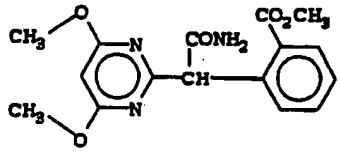
m p. 79-81°C



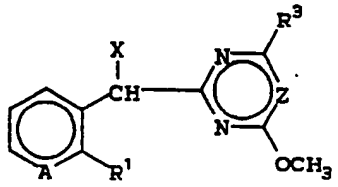
Compound 5
m p. 214-216°C



Compound 6
m p. 182-186°C



Compound 9
m p. 120-122°C



Cmpd.	X	A	R^1	R^3	Z	m.p.(°C)
10	CN	$CR^2(R^2=H)$	CO_2CH_3	OCH_3	N	Oil
11	CN	$CR^2(R^2=H)$	CO_2Et	OCH_3	CH	49-50
16	CN	$CR^2(R^2=NO_2)$	CO_2CH_3	OCH_3	CH	126-128
17	CO_2Et	$CR^2(R^2=H)$	CH_3	OCH_3	CH	Oil
18	CO_2H	$CR^2(R^2=H)$	CH_3	OCH_3	CH	81-84
19	CO_2Et	$CR^2(R^2=H)$	H	OCH_3	CH	Oil
20	CO_2Et	$CR^2(R^2=CH_3)$	H	OCH_3	CH	Oil
21	CO_2Et	$CR^2(R^2=F)$	H	OCH_3	CH	Oil
22	CO_2Et	$CR^2(R^2=H)$	H	CH_3	N	Oil

SPECTRAL DATA

Compound	Data
3	PMR($CDCl_3$,90MHz)δ 2.35(s,CH_3,3H), 3.9(s,OCH_3,6H), 4.25(s,CH_2,2H), 5.35(s,OCH_2,2H), 5.85(s,pyrmH,1H), 7.1-7.6(m, ArH,OH).
10	PMR($CDCl_3$,200MHz)δ 3.90(s,CO_2CH_3,3H), 4.00(s,OCH_3,6H), 6.99(s,CHCN,1H), 7.4-8.1(m,ArH,4H).
17	PMR($CDCl_3$,200MHz)δ 1.35(t,CH_3,3H), 2.54(s,CH_3,3H), 3.96(s,OCH_3,6H), 4.2-4.4(M,CH_2O,2H), 5.49(s,CH,1H), 6.01(s, pyrmH,1H), 7.2-7.6(m.ArH,4H).
19	PMR($CDCl_3$,200MHz)δ 1.24(t,CH_3,3H), 3.89(s,OCH_3,6H), 5.08(s,CH,1H), 5.89(s,pyrmH,1H), 7.2-7.6(m.ArH,5H).
20	PMR($CDCl_3$,200MHz)δ 1.24(t,CH_3,3H), 2.33(s,CH_3,3H), 3.89(s,OCH_3,6H), 4.1(m,OCH_2,2H), 5.05(s,CH_2,1H), 5.89(s,pyrmH,1H), 7.1-7.4(m.ArH,4H).

Compound	Data
21	IR (neat) υ co 1740cm^{-1}
22	PMR($CDCl_3$,200MHz)δ 1.23(t,CH_3,3H), 2.55(s,CH_3,3H), 4.0(s,OCH_3,3H), 4.2(q,OCH_2,2H), 5.07(s,CH,1H), 7.2-7.6(m,ArH,5H).

TEST A

Seeds of barley (Hordeum vulgare), barnyardgrass (Echinochloa crus-galli), cheatgrass (Bromus secalinus), cocklebur (Xanthium pensylvanicum), corn (Zea mays), cotton (Gossypium hirsutum), crabgrass (Digitaria spp.), bedstraw (Galium aparine), giant foxtail (Setaria faberii), morningglory (Ipomoea hederacea), rice (Oryza sativa), sorghum (Sorghum bicolor), soybean (Glycine max), sugar beet (Beta vulgaris), velvetleaf (Abutilon theophrasti), wheat (Triticum aestivum), wild oat (Avena fatua) and purple nutsedge (Cyperus rotundus) tubers were planted and treated preemergence with test chemicals dissolved in a non-phytotoxic solvent. At the same time, these crop and weed species were also treated with postemergence applications of test chemicals. Plants ranged in height from two to eighteen cm (one to four leaf stage) for postemergence treatments. Treated plants and controls were maintained in a greenhouse for twelve to sixteen days, after which all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table A, are based on a scale of 0 to 10 where 0 is no effect and 10 is complete control. A dash (-) response means no test result.

Table A

	COMPOUND			COMPOUND	
Rate (2000 g/ha)	1	6	Rate (2000 g/ha)	1	6
POSTEMERGENCE			PREEMERGENCE		
Barley	9	9	Barley	9	9
Barnyardgrass	9	9	Barnyardgrass	9	9
Cheatgrass	9	9	Cheatgrass	8	8
Cocklebur	9	-	Cocklebur	9	9
Corn	9	9	Corn	9	9
Cotton	10	9	Cotton	8	9
Crabgrass	8	7	Crabgrass	8	9
Giant foxtail	9	9	Giant foxtail	9	9
Morningglory	9	10	Morningglory	9	9
Nutsedge	10	10	Nutsedge	10	10
Rice	9	9	Rice	10	10
Sorghum	9	9	Sorghum	9	9
Soybean	9	9	Soybean	9	9
Sugar beet	9	10	Sugar beet	9	9
Velvetleaf	9	10	Velvetleaf	9	9
Wheat	9	8	Wheat	9	9
Wild Oat	9	9	Wild Oat	8	8

Table A

	COMPOUND		COMPOUND	
	Rate (1000 g/ha)	6	Rate (1000 g/ha)	6
	POSTEMERGENCE		PREEMERGENCE	
	Barley	9	Barley	9
	Barnyardgrass	8	Barnyardgrass	9
	Cheatgrass	9	Cheatgrass	8
	Cocklebur	10	Cocklebur	9
	Corn	9	Corn	7
	Cotton	9	Cotton	9
	Crabgrass	5	Crabgrass	9
	Giant foxtail	8	Giant foxtail	9
	Morningglory	10	Morningglory	8
	Nutsedge	-	Nutsedge	10
	Rice	9	Rice	9
	Sorghum	9	Sorghum	9
	Soybean	9	Soybean	9
	Sugar beet	9	Sugar beet	9
	Velvetleaf	10	Velvetleaf	9
	Wheat	8	Wheat	8
	Wild Oat	9	Wild Oat	7

Table A

	COMPOUND		COMPOUND	
	Rate (100 g/ha)	6	Rate (100 g/ha)	6
	POSTEMERGENCE		PREEMERGENCE	
	Barley	8	Barley	3
	Barnyardgrass	4	Barnyardgrass	8
	Cheatgrass	8	Cheatgrass	7
	Cocklebur	9	Cocklebur	3
	Corn	7	Corn	0
	Cotton	9	Cotton	8
	Crabgrass	4	Crabgrass	5
	Giant foxtail	5	Giant foxtail	5
	Morningglory	9	Morningglory	7
	Nutsedge	9	Nutsedge	0
	Rice	9	Rice	7
	Sorghum	9	Sorghum	9
	Soybean	9	Soybean	9
	Sugar beet	9	Sugar beet	7
	Velvetleaf	9	Velvetleaf	9
	Wheat	2	Wheat	2
	Wild Oat	7	Wild Oat	2

Table A

	COMPOUND				COMPOUND		
Rate (400 g/ha)	1	2	3	Rate (400 g/ha)	1	2	3
POSTEMERGENCE				PREEMERGENCE			
Barley	9	9	8	Barley	8	8	0
Barnyardgrass	9	9	2	Barnyardgrass	9	9	0
Cheatgrass	9	9	8	Cheatgrass	8	9	0
Cocklebur	9	9	2	Cocklebur	9	8	0
Corn	9	9	9	Corn	9	9	2
Cotton	9	3	0	Cotton	8	0	0
Crabgrass	7	5	0	Crabgrass	7	6	0
Giant foxtail	9	9	7	Giant foxtail	9	9	2
Morningglory	4	2	5	Morningglory	8	4	0
Nutsedge	10	9	9	Nutsedge	10	10	0
Rice	9	9	9	Rice	10	10	6
Sorghum	9	9	8	Sorghum	9	9	3
Soybean	9	9	9	Soybean	9	9	3
Sugar beet	9	10	10	Sugar beet	9	9	8
Velvetleaf	9	9	7	Velvetleaf	9	9	0
Wheat	9	8	2	Wheat	8	8	0
Wild Oat	9	8	6	Wild Oat	7	8	0

Table A

	COMPOUND			COMPOUND	
Rate (50 g/ha)	2	3	Rate (50 g/ha)	2	3
POSTEMERGENCE			PREEMERGENCE		
Barley	7	3	Barley	6	0
Barnyardgrass	1	0	Barnyardgrass	6	0
Cheatgrass	9	4	Cheatgrass	7	0
Cocklebur	7	1	Cocklebur	3	0
Corn	9	6	Corn	9	0
Cotton	0	0	Cotton	0	0
Crabgrass	2	0	Crabgrass	2	0
Giant foxtail	7	0	Giant foxtail	8	0
Morningglory	2	2	Morningglory	4	0
Nutsedge	5	0	Nutsedge	10	0
Rice	9	3	Rice	9	2
Sorghum	9	3	Sorghum	9	0
Soybean	9	7	Soybean	6	0
Sugar beet	9	9	Sugar beet	9	3
Velvetleaf	9	4	Velvetleaf	7	0
Wheat	3	0	Wheat	3	0
Wild Oat	0	0	Wild Oat	5	0

TEST B

Seeds of barley (Hordeum vulgare), barnyardgrass (Echinochloa crus-galli), bedstraw (Galium aparine), blackgrass (Alopecurus myosuroides), cheatgrass (Bromus secalinus), chickweed (Stellaria media), cocklebur (Xanthium pensylvanicum), corn (Zea mays), cotton (Gossypium hirsutum), crabgrass (Digitaria spp.), giant foxtail (Setaria faberii), lambsquarters (Chenopodium album), morningglory (Ipomoea hederacea), rape (Brassica napus), rice (Oryza sativa), sorghum (Sorghum bicolor), soybean (Glycine max), sugar beet (Beta vulgaris), velvetleaf (Abutilon theophrasti), wheat (Triticum aestivum), wild buckwheat (Polygonum convolvulus), and wild oat (Avena fatua) and purple nutsedge (Cyperus rotundus) tubers were planted and treated preemergence with test chemicals dissolved in a non-phytotoxic solvent. At the same time, these crop and weed species were also treated with postemergence applications of test chemicals. Plants ranged in height from two to eighteen cm (one to four leaf stage) for postemergence treatments. Treated plants and controls were maintained in a greenhouse for approximately twelve to sixteen days, after which all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 10 where 0 is no effect and 10 is complete control. A dash (-) response means no test result.

Table B

	COMPOUND		COMPOUND	
	Rate (2000 g/ha)	9	Rate (2000 g/ha)	9
	POSTEMERGENCE		PREEMERGENCE	
	Barley	7	Barley	7
	Barnyardgrass	2	Barnyardgrass	6
	Bedstraw	-	Bedstraw	9
	Blackgrass	6	Blackgrass	8
	Cheatgrass	6	Cheatgrass	9
	Chickweed	7	Chickweed	9
	Cocklebur	2	Cocklebur	3
	Corn	4	Corn	2
	Cotton	9	Cotton	8
	Crabgrass	2	Crabgrass	-
	Giant foxtail	3	Giant foxtail	2
	Lambsquarters	6	Lambsquarters	9
	Morningglory	4	Morningglory	2
	Nutsedge	9	Nutsedge	-
	Rape	5	Rape	7
	Rice	4	Rice	8
	Sorghum	9	Sorghum	7
	Soybean	9	Soybean	9
	Sugar beet	9	Sugar beet	9
	Velvetleaf	9	Velvetleaf	8
	Wheat	2	Wheat	2
	Wild Buckwheat	8	Wild Buckwheat	9
	Wild Oat	2	Wild Oat	7

Table B

	COMPOUND				COMPOUND		
Rate (400 g/ha)	4	5	9	Rate (400 g/ha)	4	5	9
POSTEMERGENCE				PREEMERGENCE			
Barley	3	3	2	Barley	0	0	0
Barnyardgrass	2	0	0	Barnyardgrass	0	0	2
Bedstraw	9	9	4	Bedstraw	6	8	7
Blackgrass	0	2	4	Blackgrass	5	4	4
Cheatgrass	2	5	2	Cheatgrass	0	4	6
Chickweed	6	8	6	Chickweed	6	5	9
Cocklebur	1	6	3	Cocklebur	7	2	2
Corn	0	0	2	Corn	0	0	-
Cotton	4	8	6	Cotton	0	5	8
Crabgrass	0	2	2	Crabgrass	2	0	-
Giant foxtail	0	3	2	Giant foxtail	2	2	2
Lambsquarters	7	8	5	Lambsquarters	10	10	-
Morningglory	1	6	3	Morningglory	0	2	1
Nutsedge	5	9	8	Nutsedge	0	9	-
Rape	3	5	2	Rape	3	3	0
Rice	0	5	2	Rice	0	3	2
Sorghum	3	7	8	Sorghum	0	2	5
Soybean	9	9	9	Soybean	3	9	8
Sugar beet	9	9	9	Sugar beet	4	6	9
Velvetleaf	8	9	7	Velvetleaf	3	8	8
Wheat	0	0	0	Wheat	0	0	0
Wild Buckwheat	9	8	7	Wild Buckwheat	6	3	6
Wild Oat	0	1	2	Wild Oat	0	2	2

Table B

	COMPOUND			COMPOUND	
Rate (100 g/ha)	4	5	Rate (100 g/ha)	4	5
POSTEMERGENCE			PREEMERGENCE		
Barley	0	0	Barley	0	0
Barnyardgrass	0	0	Barnyardgrass	0	0
Bedstraw	9	7	Bedstraw	2	7
Blackgrass	0	0	Blackgrass	3	2
Cheatgrass	0	2	Cheatgrass	0	2
Chickweed	4	5	Chickweed	5	4
Cocklebur	0	2	Cocklebur	5	-
Corn	0	0	Corn	0	0
Cotton	2	7	Cotton	0	0
Crabgrass	0	0	Crabgrass	0	0
Giant foxtail	0	0	Giant foxtail	2	2
Lambsquarters	5	7	Lambsquarters	10	0
Morningglory	1	5	Morningglory	0	0
Nutsedge	2	9	Nutsedge	0	5
Rape	0	2	Rape	0	2
Rice	0	3	Rice	0	0
Sorghum	0	4	Sorghum	0	0
Soybean	9	9	Soybean	2	8
Sugar beet	8	8	Sugar beet	0	1
Velvetleaf	5	8	Velvetleaf	2	0
Wheat	0	0	Wheat	0	0
Wild Buckwheat	8	8	Wild Buckwheat	2	4
Wild Oat	0	0	Wild Oat	0	0

Table B

	COMPOUND	
Rate (2000 g/ha)	10	16
POSTEMERGENCE		
Barley	9	6
Barnyardgrass	9	6
Bedstraw	7	9
Blackgrass	9	8
Cheatgrass	9	8
Chickweed	9	-
Cocklebur	9	-
Corn	6	2
Cotton	9	9
Crabgrass	7	2
Giant foxtail	8	8
Lambsquarters	9	9
Morningglory	8	9
Nutsedge	9	8
Rape	10	9
Rice	9	9
Sorghum	9	9
Soybean	9	9
Sugar beet	10	10
Velvetleaf	9	9
Wheat	6	6
Wild buckwheat	10	9
Wild oat	5	3

Table B	COMPOUND	
Rate (2000 g/ha)	10	16
PREEMERGENCE		
Barley	9	0
Barnyardgrass	8	5
Bedstraw	7	9
Blackgrass	9	6
Cheatgrass	8	8
Chickweed	10	9
Cocklebur	-	-
Corn	3	1
Cotton	7	6
Crabgrass	5	2
Giant foxtail	7	1
Lambsquarters	9	9
Morningglory	5	2
Nutsedge	5	7
Rape	8	9
Rice	7	9
Sorghum	8	4
Soybean	9	9
Sugar beet	9	9

Table B	COMPOUND	
Velvetleaf	7	6
Wheat	7	4
Wild buckwheat	7	9
Wild oat	6	0

Table B	COMPOUND
Rate (1000 g/ha)	19
POSTEMERGENCE	
Barley	8
Barnyardgrass	9
Bedstraw	8
Blackgrass	9
Cheatgrass	9
Chickweed	10
Corn	9
Cotton	5
Crabgrass	8
Giant foxtail	8
Lambsquarters	9
Morningglory	9
Nutsedge	-
Rape	9
Rice	9
Sorghum	9
Soybean	6
Sugar beet	10
Velvetleaf	5
Wheat	8
Wild buckwheat	9
Wild oat	9

Table B	COMPOUND
Rate (1000 g/ha)	19
PREEMERGENCE	
Barley	7
Barnyardgrass	9
Bedstraw	9
Blackgrass	9
Cheatgrass	8
Chickweed	9
Corn	9
Cotton	8
Crabgrass	9
Giant foxtail	9
Lambsquarters	9
Morningglory	5
Nutsedge	9
Rape	6
Rice	9
Sorghum	9

Table B	COMPOUND
Rate (1000 g/ha)	19
Soybean	8
Sugar beet	9
Velvetleaf	2
Wheat	9
Wild buckwheat	8
Wild oat	9

Table B	COMPOUND			
Rate (400 g/ha)	10	11	16	18
POSTEMERGENCE				
Barley	9	0	6	0
Barnyardgrass	9	0	3	-
Bedstraw	7	3	8	2
Blackgrass	9	0	5	1
Cheatgrass	8	0	8	0
Chickweed	9	7	9	3
Cocklebur	9	-	-	-
Corn	4	0	0	1
Cotton	9	5	6	0
Crabgrass	4	0	0	0
Giant foxtail	7	0	7	0
Lambsquarters	8	8	8	0
Morningglory	7	3	9	0
Nutsedge	-	6	7	0
Rape	9	2	9	0
Rice	8	2	7	0
Sorghum	9	0	8	3
Soybean	9	9	9	0
Sugar beet	10	9	9	3
Velvetleaf	9	5	9	0
Wheat	5	0	2	2
Wild buckwheat	9	8	8	0
Wild oat	3	0	0	0

Table B

	COMPOUND			
Rate (400 g/ha)	10	11	16	18
PREEMERGENCE				
Barley	8	0	0	0
Barnyardgrass	7	0	3	3
Bedstraw	2	5	3	0
Blackgrass	8	4	0	0
Cheatgrass	8	3	8	5
Chickweed	0	6	4	0
Cocklebur	-	-	-	-
Corn	2	0	0	0
Cotton	6	4	0	0
Crabgrass	2	0	0	2
Giant foxtail	3	0	1	2
Lambsquarters	9	8	9	0
Morningglory	2	0	0	0
Nutsedge	0	0	0	-
Rape	7	2	3	0
Rice	6	0	7	2
Sorghum	7	1	0	9
Soybean	9	8	6	0
Sugar beet	8	2	9	2
Velvetleaf	3	1	3	1
Wheat	5	0	2	0
Wild buckwheat	2	4	3	0
Wild oat	4	2	0	2

Table B	COMPOUND
Rate (200 g/ha)	19
POSTEMERGENCE	
Barley	5
Barnyardgrass	8
Bedstraw	6
Blackgrass	7
Cheatgrass	7
Chickweed	7
Cocklebur	-
Corn	8
Cotton	0
Crabgrass	6
Giant foxtail	4
Lambsquarters	9
Morningglory	1
Nutsedge	6
Rape	7
Rice	8
Sorghum	7
Soybean	4
Sugar beet	8
Velvetleaf	2
Wheat	2
Wild buckwheat	7
Wild Oat	5

Table B	COMPOUND	
Rate (200 g/ha)	12	19
PREEMERGENCE		
Barley	9	3
Barnyardgrass	7	8
Bedstraw	9	9
Blackgrass	3	8
Cheatgrass	9	8
Chickweed	10	9
Cocklebur	-	-
Corn	1	5
Cotton	8	1
Crabgrass	2	9
Giant foxtail	2	8
Lambsquarters	9	10
Morningglory	9	0
Nutsedge	7	5
Rape	9	6
Rice	8	6
Sorghum	8	5
Soybean	9	2
Sugar beet	9	9
Velvetleaf	9	0
Wheat	8	7
Wild buckwheat	9	3
Wild oat	8	8

Table B

Rate (100 g/ha)	COMPOUND 11	COMPOUND 18
POSTEMERGENCE		
Barley	0	0
Barnyardgrass	0	-
Bedstraw	2	0
Blackgrass	0	0
Cheatgrass	0	0
Chickweed	0	0
Cocklebur	-	-
Corn	0	0
Cotton	2	0
Crabgrass	0	0
Giant foxtail	0	0
Lambsquarters	4	0
Morningglory	1	0
Nutsedge	0	0
Rape	0	0
Rice	0	0
Sorghum	0	2
Soybean	8	0
Sugar beet	8	3
Velvetleaf	0	0
Wheat	0	0
Wild buckwheat	7	0
Wild oat	0	0

Table B COMPOUND

Rate (100 g/ha)	11	18
PREEMERGENCE		
Barley	0	0
Barnyardgrass	0	0
Bedstraw	0	0
Blackgrass	2	0
Cheatgrass	0	2
Chickweed	0	0
Cocklebur	-	-
Corn	0	0
Cotton	0	0
Crabgrass	0	0
Giant foxtail	0	0
Lambsquarters	0	0
Morningglory	0	0
Nutsedge	0	0
Rape	0	0
Rice	0	0
Sorghum	0	3
Soybean	6	0
Sugar beet	0	2
Velvetleaf	0	0
Wheat	0	0
Wild buckwheat	0	0
Wild oat	0	0

TEST C

Seeds of barley (Hordeum vulgare), barnyardgrass (Echinochloa crus-galli), blackgrass (Alopecurus myosuroides), chickweed (Stellaria media), cocklebur (Xanthium pensylvanicum), corn (Zea mays), cotton (Gossypium hirsutum), crabgrass (Digitaria spp.), downy brome (Bromus tectorum), giant foxtail (Setaria faberii), green foxtail (Setaria viridis), jimsonweed (Datura stramonium), johnsongrass (Sorghum halepense), lambsquarters (Chenopodium album), morningglory (Ipomoea spp.), rape (Brassica napus), rice (Oryza sativa), sicklepod (Cassia obtusifolia), soybean (Glycine max), sugar beet (Beta vulgaris), teaweed (Sida spinosa), velvetleaf (Abutilon theophrasti), wheat (Triticum aestivum), wild buckwheat (Polygonum convolvulus), and wild oat (Avena fatua) and purple nutsedge (Cyperus rotundus) tubers were planted and treated preemergence with test chemicals dissolved in a non-phytotoxic solvent. At the same time, these crop and weed species were also treated with postemergence applications of test chemicals. Plants ranged in height from two to eighteen cm (two to three leaf stage) for postemergence treatments. Treated plants and controls were maintained in a greenhouse for approximately eighteen to twenty-four days, after which all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table C, are reported on a 0 to 10 scale where 0 is no effect and 10 is complete control. A dash (-) response means no test result.

Table C

	COMPOUND		COMPOUND	
	Rate (250 g/ha)	1	Rate (250 g/ha)	1
	POSTEMERGENCE		PREEMERGENCE	
	Barley	8	Barley	7
	Barnyardgrass	9	Barnyardgrass	10
	Blackgrass	7	Blackgrass	7
	Chickweed	10	Chickweed	9
	Cocklebur	9	Cocklebur	10
	Corn	10	Corn	10
	Cotton	3	Cotton	4
	Crabgrass	7	Crabgrass	8
	Downy brome	7	Downy brome	8
	Giant foxtail	9	Giant foxtail	7
	Green foxtail	7	Green foxtail	8
	Jimsonweed	9	Jimsonweed	8
	Johnsongrass	9	Johnsongrass	8
	Lambsquarters	10	Lambsquarters	-
	Morningglory	4	Morningglory	8
	Nutsedge	9	Nutsedge	10
	Rape	9	Rape	10
	Rice	9	Rice	10
	Sicklepod	8	Sicklepod	8
	Soybean	9	Soybean	8
	Sugar beet	10	Sugar beet	10
	Teaweed	9	Teaweed	9
	Velvetleaf	10	Velvetleaf	9
	Wheat	6	Wheat	6
	Wild buckwheat	10	Wild buckwheat	9
	Wild oat	7	Wild oat	7

Table C

	COMPOUND			COMPOUND	
Rate (62 g/ha)	1	6	Rate (62 g/ha)	1	6
POSTEMERGENCE			PREEMERGENCE		
Barley	5	5	Barley	5	4
Barnyardgrass	9	8	Barnyardgrass	7	8
Blackgrass	7	3	Blackgrass	5	3
Chickweed	10	10	Chickweed	7	2
Cocklebur	7	8	Cocklebur	10	6
Corn	10	3	Corn	6	2
Cotton	2	9	Cotton	3	9
Crabgrass	6	2	Crabgrass	7	0
Downy brome	5	7	Downy brome	7	9
Giant foxtail	8	4	Giant foxtail	3	3
Green foxtail	4	4	Green foxtail	6	0
Jimsonweed	9	8	Jimsonweed	7	9
Johnsongrass	7	8	Johnsongrass	7	9
Lambsquarters	-	10	Lambsquarters	-	10
Morningglory	0	9	Morningglory	6	9
Nutsedge	9	3	Nutsedge	7	9
Rape	8	10	Rape	8	4
Rice	9	7	Rice	10	2
Sicklepod	8	6	Sicklepod	7	9
Soybean	8	9	Soybean	6	9
Sugar beet	10	10	Sugar beet	10	9
Teaweed	8	9	Teaweed	9	9
Velvetleaf	10	9	Velvetleaf	9	3
Wheat	4	3	Wheat	4	4
Wild buckwheat	9	9	Wild buckwheat	8	9
Wild oat	4	4	Wild oat	5	4

Table C

	COMPOUND			COMPOUND	
Rate (16 g/ha)	1	6	Rate (16 g/ha)	1	6
POSTEMERGENCE			PREEMERGENCE		
Barley	4	2	Barley	3	2
Barnyardgrass	4	4	Barnyardgrass	6	4
Blackgrass	6	0	Blackgrass	4	0
Chickweed	6	8	Chickweed	5	0
Cocklebur	2	5	Cocklebur	9	3
Corn	9	3	Corn	4	0
Cotton	0	8	Cotton	3	9
Crabgrass	3	0	Crabgrass	5	0
Downy brome	4	5	Downy brome	6	7
Giant foxtail	4	2	Giant foxtail	0	0
Green foxtail	2	2	Green foxtail	3	0
Jimsonweed	7	5	Jimsonweed	6	9
Johnsongrass	6	7	Johnsongrass	6	8
Lambsquarters	9	10	Lambsquarters	-	3
Morningglory	0	9	Morningglory	6	9
Nutsedge	4	2	Nutsedge	5	3
Rape	6	9	Rape	8	0
Rice	8	5	Rice	8	0
Sicklepod	4	5	Sicklepod	6	6
Soybean	6	8	Soybean	4	9
Sugar beet	10	9	Sugar beet	9	8
Teaweed	6	7	Teaweed	9	9
Velvetleaf	8	9	Velvetleaf	9	0
Wheat	2	2	Wheat	3	2
Wild buckwheat	9	8	Wild buckwheat	7	8
Wild oat	2	2	Wild oat	3	2

Table C

	COMPOUND			COMPOUND	
Rate (4 g/ha)	1	6	Rate (4 g/ha)	1	6
POSTEMERGENCE			PREEMERGENCE		
Barley	2	0	Barley	0	0
Barnyardgrass	2	0	Barnyardgrass	3	3
Blackgrass	4	0	Blackgrass	4	0
Chickweed	4	7	Chickweed	3	0
Cocklebur	0	5	Cocklebur	7	0
Corn	5	0	Corn	2	0
Cotton	0	8	Cotton	0	-
Crabgrass	0	0	Crabgrass	3	0
Downy brome	3	3	Downy brome	4	2
Giant foxtail	1	0	Giant foxtail	0	0
Green foxtail	2	0	Green foxtail	3	0
Jimsonweed	5	5	Jimsonweed	3	9
Johnsongrass	3	4	Johnsongrass	4	5
Lambsquarters	8	8	Lambsquarters	-	0
Morningglory	0	8	Morningglory	-	5
Nutsedge	4	0	Nutsedge	3	0
Rape	5	7	Rape	7	0
Rice	7	3	Rice	4	0
Sicklepod	4	4	Sicklepod	5	4
Soybean	4	6	Soybean	3	8
Sugar beet	10	9	Sugar beet	8	3
Teaweed	4	5	Teaweed	8	8
Velvetleaf	7	7	Velvetleaf	8	0
Wheat	0	0	Wheat	0	0
Wild buckwheat	7	6	Wild buckwheat	6	2
Wild oat	0	0	Wild oat	0	0

TEST D

The compound evaluated in this test was formulated in a non-phytoxic solvent and applied to the soil surface before plant seedlings emerged (preemergence application), to water that covered the soil surface (paddy application), and to plants that were in the one-to-four leaf stage (postemergence application). A sandy loam soil was used for the preemergence and postemergence tests, while a silt loam soil was used in the paddy test. Water depth was approximately 2.5 cm for the paddy test and was maintained at this level for the duration of the test.

Plant species in the preemergence and postemergence tests consisted of barley (Hordeum vulgare), bedstraw (Galium aparine), blackgrass (Alopecurus myosuroides), chickweed (Stellaria media), corn (Zea mays), cotton (Gossypium hirsutum), crabgrass (Digitaria sanguinalis), downy brome (Bromus tectorum), giant foxtail (Setaria faberii), lambsquarters (Chenopodium album), morningglory (Ipomoea hederacea), pigweed (Amaranthus retroflexus), rape (Brassica napus), ryegrass (Lolium multiflorum), sorghum (Sorghum bicolor), soybean (Glycine max), speedwell (Veronica persica), sugar beet (Beta vulgaris), velvetleaf (Abutilon theophrasti), wheat (Triticum aestivum), wild buckwheat (Polygonum convolvulus), and wild oat (Avena fatua). All plant species were planted one day before application of the compound for the preemergence portion of this test. Plantings of these species were adjusted to produce plants of appropriate size for the postemergence portion of the test. Plant species in the paddy test consisted of barnyardgrass (Echinochloa crus-galli), rice (Oryza sativa), and umbrella sedge (Cyperus difformis).

All plant species were grown using normal greenhouse practices. Visual evaluations of injury expressed on treated plants, when compared to untreated controls, were recorded approximately fourteen to twenty-one days after application of the test compound. Plant response ratings, summarized in Table D, were recorded on a zero to ten scale where zero is no injury and ten is plant death. A dash (-) response means no test result.

Table D

	COMPOUND		COMPOUND
Rate (500 g/ha)	2	Rate (500 g/ha)	2
POSTEMERGENCE		PADDY	
Barley	10	Barnyardgrass	8
Bedstraw	10	Rice	8
Blackgrass	10	Umbrella sedge	9
Chickweed	10		
Corn	10		
Cotton	6		
Crabgrass	4		
Downy brome	9		
Giant foxtail	9		
Lambsquarters	10		
Morningglory	6		
Pigweed	10		
Rape	9		
Ryegrass	7		
Sorghum	7		
Soybean	10		
Speedwell	10		
Sugar beet	10		
Velvetleaf	10		
Wheat	8		
Wild buckwheat	10		
Wild oat	8		

Table D

	COMPOUND		COMPOUND	
	Rate (500 g/ha)	2	Rate (250 g/ha)	2
	PREEMERGENCE		POSTEMERGENCE	
	Barley	8	Barley	10
	Bedstraw	9	Bedstraw	10
	Blackgrass	7	Blackgrass	10
	Chickweed	9	Chickweed	10
	Corn	10	Corn	10
	Cotton	5	Cotton	4
	Crabgrass	8	Crabgrass	3
	Downy brome	8	Downy brome	9
	Giant foxtail	9	Giant foxtail	9
	Lambsquarters	9	Lambsquarters	10
	Morningglory	8	Morningglory	4
	Pigweed	10	Pigweed	10
	Rape	9	Rape	8
	Ryegrass	9	Ryegrass	-
	Sorghum	10	Sorghum	7
	Soybean	9	Soybean	10
	Speedwell	9	Speedwell	10
	Sugar beet	9	Sugar beet	10
	Velvetleaf	9	Velvetleaf	10
	Wheat	8	Wheat	8
	Wild buckwheat	9	Wild buckwheat	10
	Wild oat	7	Wild oat	6

Table D

	COMPOUND		COMPOUND	
	Rate (250 g/ha)	2	Rate (250 g/ha)	2
	PADDY		PREEMERGENCE	
	Barnyardgrass	7	Barley	8
	Rice	8	Bedstraw	9
	Umbrella sedge	9	Blackgrass	6
			Chickweed	9
			Corn	9
			Cotton	4
			Crabgrass	8
			Downy brome	8
			Giant foxtail	8
			Lambsquarters	9
			Morningglory	7
			Pigweed	10
			Rape	9
			Ryegrass	8
			Sorghum	10
			Soybean	9
			Speedwell	9
			Sugar beet	9
			Velvetleaf	9
			Wheat	7
			Wild buckwheat	9
			Wild oat	7

Table D

	COMPOUND		COMPOUND	
	Rate (125 g/ha)	2	Rate (125 g/ha)	2
	POSTEMERGENCE		PADDY	
	Barley	9	Barnyardgrass	7
	Bedstraw	10	Rice	8
	Blackgrass	9	Umbrella sedge	9
	Chickweed	10		
	Corn	7		
	Cotton	4		
	Crabgrass	0		
	Downy brome	9		
	Giant foxtail	7		
	Lambsquarters	10		
	Morningglory	2		
	Pigweed	10		
	Rape	6		
	Ryegrass	7		
	Sorghum	6		
	Soybean	10		
	Speedwell	10		
	Sugar beet	10		
	Velvetleaf	10		
	Wheat	7		
	Wild buckwheat	10		
	Wild oat	5		

Table D

	COMPOUND		COMPOUND	
	Rate (125 g/ha)	2	Rate (62 g/ha)	2
	PREEMERGENCE		POSTEMERGENCE	
	Barley	7	Barley	8
	Bedstraw	9	Bedstraw	10
	Blackgrass	6	Blackgrass	9
	Chickweed	9	Chickweed	10
	Corn	9	Corn	6
	Cotton	2	Cotton	2
	Crabgrass	7	Crabgrass	0
	Downy brome	7	Downy brome	8
	Giant foxtail	7	Giant foxtail	6
	Lambsquarters	9	Lambsquarters	10
	Morningglory	7	Morningglory	0
	Pigweed	10	Pigweed	10
	Rape	8	Rape	5
	Ryegrass	8	Ryegrass	6
	Sorghum	10	Sorghum	6
	Soybean	8	Soybean	10
	Speedwell	9	Speedwell	10
	Sugar beet	9	Sugar beet	9
	Velvetleaf	8	Velvetleaf	10
	Wheat	7	Wheat	6
	Wild buckwheat	9	Wild buckwheat	10
	Wild oat	6	Wild oat	4

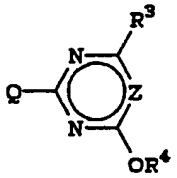
Table D

COMPOUND		COMPOUND	
Rate (62 g/ha)	2	Rate (62 g/ha)	2
PADDY		PREEMERGENCE	
Barnyardgrass	7	Barley	6
Rice	8	Bedstraw	9
Umbrella sedge	8	Blackgrass	5
		Chickweed	8
		Corn	8
		Cotton	0
		Crabgrass	5
		Downy brome	7
		Giant foxtail	6
		Lambsquarters	9
		Morningglory	7
		Pigweed	10
		Rape	8
		Ryegrass	7
		Sorghum	9
		Soybean	8
		Speedwell	9
		Sugar beet	8
		Velvetleaf	8
		Wheat	4
		Wild buckwheat	9
		Wild oat	5

CLAIMS

What is claimed:

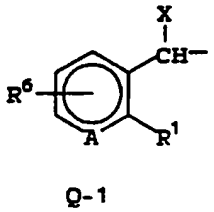
1. A compound of the formula:



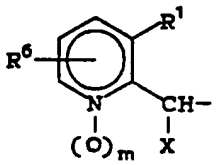
I

wherein

Q is



Q-1



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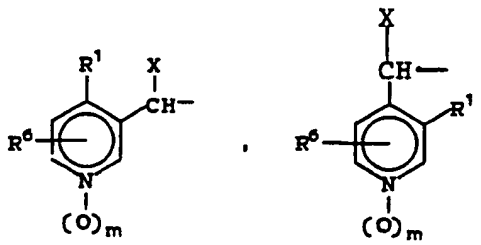

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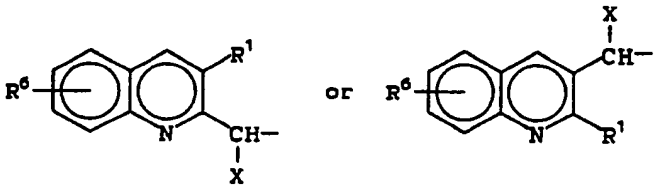
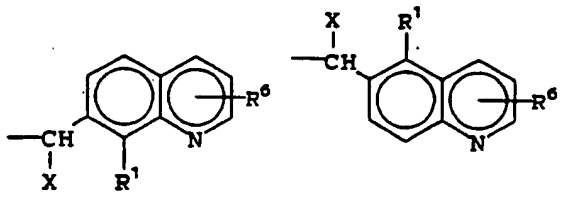
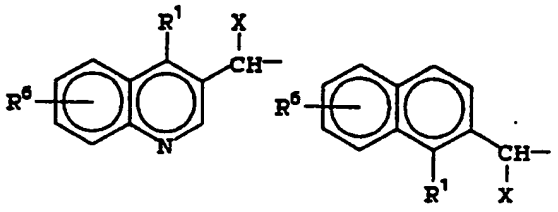


Q-5 Q-6



Q-7 Q-8



Q-9 Q-10

A is CR^2, N or N-O;

X is H, F, Cl, CH_3, OH, $C(O)NR^{12}R^{13}$, CO_2R^{14} or CN;

R^1 is H, CHO, $C(OCH_3)_2H$, CO_2R^5 or $C(O)SR^{11}$;

R^2 is H, F, Cl, C_1-C_2 alkyl, C_1-C_2-alkoxy, C_2-C_3 alkynyl, C_2-C_3 alkenyl, $S(O)_nC_1$-C_2 alkyl, NO_2, phenoxy, C_2-C_4 alkylcarbonyl, $C(OCH_3)_2CH_3$, or $C(SCH_3)_2CH_3$;

R^3 is C_1-C_2 alkyl, C_1-C_2 alkoxy, OCF_2H or Cl;

R^4 is C_1-C_2 alkyl;

R^5 is H; M; C_1-C_3 alkyl; C_2-C_3 haloalkyl; allyl; propargyl; benzyl optionally substituted with halogen, C_1-C_2 alkyl, C_1-C_2 alkoxy, CF_3, NO_2, SCH_3, $S(O)CH_3$, or $S(O)_2CH_3$; C_2-C_4 alkoxyalkyl; $N{=}CR^7R^8$; or $CHR^9S(O)_nR^{10}$;

R^6 is H, F, Cl, CH_3, OCH_3 or $S(O)_nCH_3$;

R^7 is Cl, C_1-C_2 alkyl or SCH_3;

R^8 is C_1-C_2 alkyl, CO_2(C_1-C_2 alkyl) or $C(O)N(CH_3)_2$;

R^9 is H or CH_3;

R^{10} is C_1-C_3 alkyl or phenyl optionally substituted with halogen, CH_3, OCH_3 or NO_2;

R^{11} is C_1-C_2 alkyl or benzyl;

R^{12} is H or CH_3;

R^{13} is H or CH_3;

R^{14} is H, C_1-C_3 alkyl, C_2-C_5 haloalkyl, C_3-C_5 alkenyl, C_3-C_5 alkynyl, C_2-C_5 alkoxyalkyl or benzyl optionally substituted with CH_3, OCH_3, SCH_3, halogen, NO_2 or CF_3;

m is 0 or 1;

n is 0, 1 or 2;

M is a alkali metal atom or an alkaline earth metal atom, an ammonium group or an alkylammonium group; and

Z is CH or N.

and their agriculturally suitable salts; provided that:

(a) when R^1 is H, then X is CO_2R^{14};

(b) when X is CO_2R^{14}, then R^1 is H; and.

(c) when Z is N, then R^3 is C_1-C_2 alkyl or C_1-C_2 alkoxy.

2. The compounds of Claim 1 wherein Q is Q-1 or Q-2.

3. The compounds of Claim 2 wherein R^2 is H, F, Cl, CH_3, SCH_3, OCH_3 or OCH_2CH_3.

4. The compounds of Claim 3 wherein
R^6 is H;
Z is CH;
R^3 is OCH_3;
R^4 is CH_3; and
X is H.

5. The compounds of Claim 3 wherein
R^6 is H or 3-F;
Z is CH;
R^3 is OCH_3;
R^4 is CH_3;
X is CO_2R^{14}; and
R^{14} is C_1-C_3 alkyl, allyl, propargyl or benzyl.

6. The compound of Claim 3 which is 2-[cyano(4,6-dimethoxy-2-pyrimidinyl)methyl]-benzoic acid.

7. The compounds of Claim 4 wherein
Q is Q-1;
R^1 is CO_2R^5; and
R^5 is H or M.

8. The compounds of Claim 4 wherein
Q is Q-2;
R^1 is CO_2R^5; and
R^5 is H or M.

9. The compound of Claim 5 which is ethyl 4,6-dimethoxy-alpha-phenyl-2-pyrimidineacetate.

10. The compound of Claim 7 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl-benzoic acid.

11. The compound of Claim 7 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-6-methyl benzoic acid, sodium salt.

12. The compound of Claim 7 which is 2-[(4,6-dimethoxy-2-pyrimidinyl)methyl]-3-pyridine carboxylic acid.

13. A composition suitable for controlling the growth of undesired vegetation which comprises an effective amount of a compound of Claim 1 and at least one of the following: surfactant, solid or liquid diluent.

14. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 2 and at least one of the following: surfactant, solid or liquid diluent.

15. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 3 and at least one of the following: surfactant, solid or liquid diluent.

16. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 4 and at

least one of the following: surfactant, solid or liquid diluent.

17. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 5 and at least one of the following: surfactant, solid or liquid diluent.

18. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 6 and at least one of the following: surfactant, solid or liquid diluent.

19. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 7 and at least one of the following: surfactant, solid or liquid diluent.

20. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 8 and at least one of the following: surfactant, solid or liquid diluent.

21. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 9 and at least one of the following: surfactant, solid or liquid diluent.

22. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 10 and at least one of the following: surfactant, solid or liquid diluent.

23. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 11 and at least one of the following: surfactant, solid or liquid diluent.

24. A composition suitable for controlling the growth of undesired vegetation which compresses an effective amount of a compound of Claim 12 and at least one of the following: surfactant, solid or liquid diluent.

25. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 1.

26. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 2.

27. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 3.

28. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 4.

29. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 5.

30. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 6.

31. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 7.

32. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 8.

33. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 9.

34. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 10.

35. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 11.

36. A method for controlling the growth of undesired vegetation which compresses applying to the locus to be protected an effective amount of a compound of Claim 12.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 90/07417

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: C 07 D 239/52,C 07 D 251/20,C 07 D 401/06,A 01 N 43/54, A 01 N 43/66

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	C 07 D 239/00,C 07 D 251/00,C 07 D 406/00,A 01 N

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	GB, A, 1 585 950 (ICI) 11 March 1981 (11.03.81), see claims 1,12, 14; compounds No. 106-113. --	1,13, 25
P,A	EP, A2, 0 360 163 (BASF) 28 March 1990 (28.03.90), see claims 1,5,8 (cited in the application). --	1,13, 25
A	DE, A1, 2 656 183 (AKZO) 23 June 1977 (23.06.77), see claim 2. ----	1

* Special categories of cited documents: [14]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
03 April 1991	17 MAY 1991
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	MISS D. S. KOWALCZYK

Form PCT/ISA/210 (second sheet) (January 1985)

ANHANG
zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

ANNEX
to the International Search Report to the International Patent Application No.

ANNEXE
au rapport de recherche international relatif á la demande de brevet international n°

SA44312

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The Office is in no way liable for these particulars which are given merely for the purpose of information.

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les reseignements fournis sont donnés á titre indicatif et n'engagent pas la responsibilité de l'Office.

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